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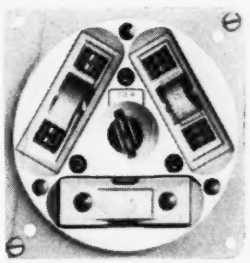

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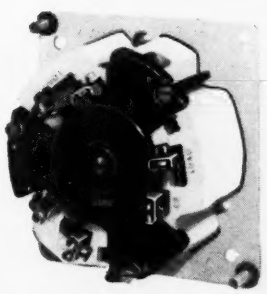

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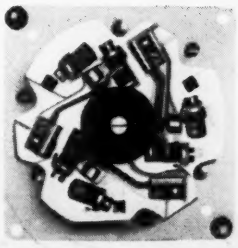

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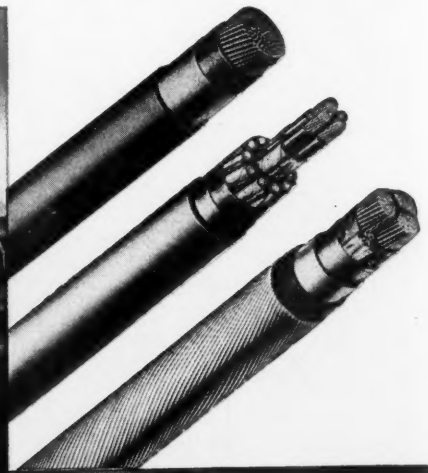

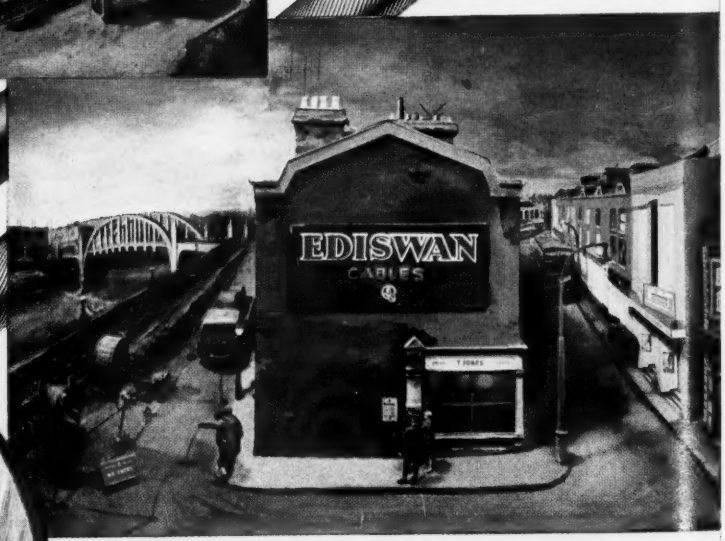

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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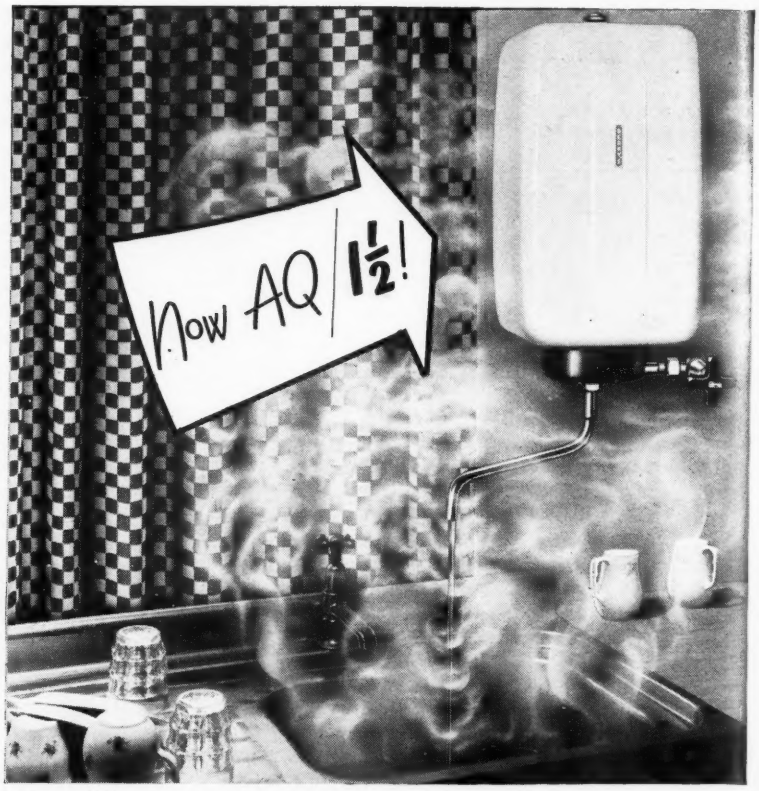

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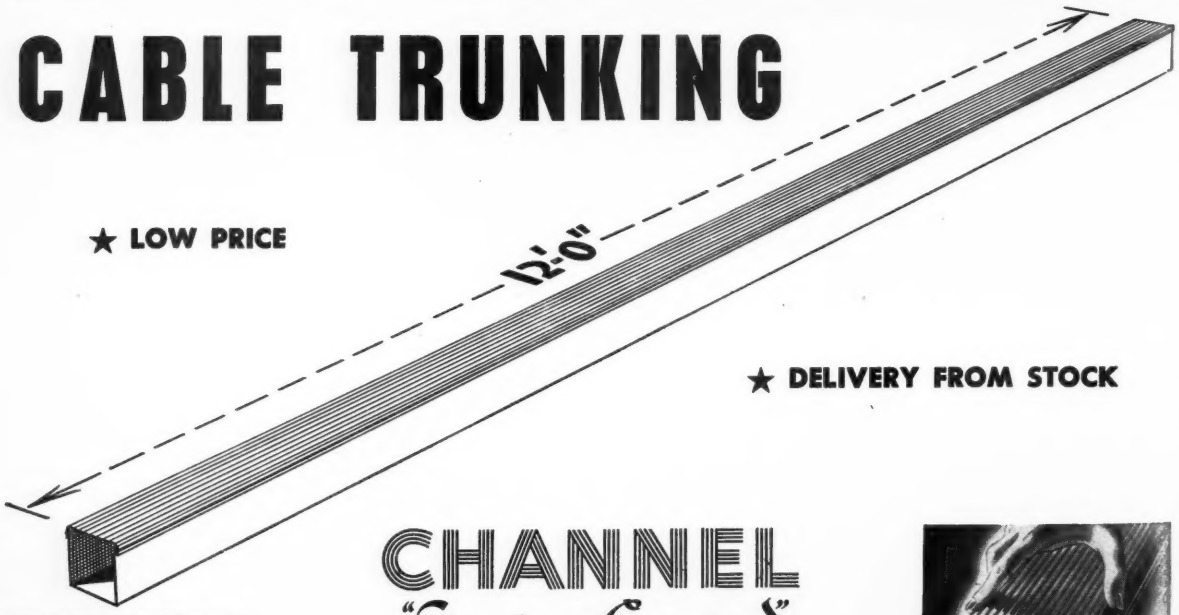

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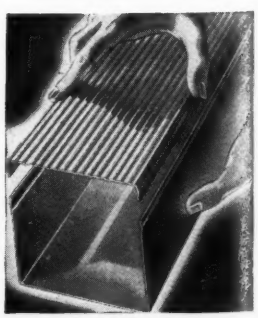

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ELECTRICAL REVIEW

15 February 1957 Vol. 160 No. 7 Established 1872

Coal and Electricity

In the course of his Cadman Memorial Lecture " Mining Education and Training " before the Royal Society of Arts, Mr. I. C. F. Statham said:—" It has been suggested by some that the dawn of the atomic era means that the coal age is rapidly drawing to a close, but such a conception is at variance with the well recognised facts. In the foreseeable future or at all events for several generations ahead, we shall need more and more coal as a source of our growing power requirements. To meet this need the coal industry is being reconstructed, new pits are being sunk, old pits are being remodelled, mechanisation is growing apace and up-to-date management techniques are being rapidly introduced."

We quote this passage in support of our contention, which we stress once again is most vital to the electrical industry, that, despite the far greater importance of the development of nuclear energy in the long run, coal is, and must remain for a long time, the basis of electricity generation. To allow the idea that the coal age is rapidly drawing to a close would be fatal to our industry.

Moreover, the electrical industry should be intensely proud of the fact that it is probably making the greatest outside contribution to " The Rebirth of an Industry," to use the title of the National Coal Board's recent brochure marking the first ten years of nationalisation of the coal industry. Referring to this brochure, which we recommend every electrical man to read, Mr. Statham says he has no hesitation in stating that the importance attached by the Board to the problems of education and training has played a major part in the " rebirth " as well as in the " renaissance of management " discussed in a recent article by Sir Andrew Bryan, a member of the Board.

Not the least amongst the achievements of the first ten years of nationalisation is the better understanding which now pervades the industry. In addition, the mines are safer, healthier and more productive. The death rate over the last ten years was some 40 per cent less than in the preceding ten years, while the output of coal rose by about 16 per cent and output per man-shift by about 10 per cent. So many factors are involved that it is not possible to estimate how far these improvements are due to better education and training, but the lecturer gave it as his opinion that they had made an important contribution and would continue to do so increasingly as the effects became operative in the future. It should also be recognised that a very great part of the improvement has arisen from the mechanisation of the mines, which in the modern sense means electrification.

NUCLEAR PROGRESS

It has been suggested in certain quarters during the last few months that Calder Hall nuclear generation may not be so reliable and successful as was originally thought. We now know that this is far from being the case, because last week Sir Christopher Hinton gave a most satisfactory progress report on the plant. By the starting up of the second reactor, Calder Hall "A" is now complete and in operation with an installed capacity of 92 MW, the commissioning having involved far less trouble than is normally experienced with a conventional power station or chemical plant.

Shut-downs have been less frequent than anticipated and the plant has been on load for 90 per cent of the time since it was first started up. In each reactor there are about 10,000 fuel elements, and in eight months only two of them have failed and had to be replaced. Some difficulties have arisen, but these have all been overcome. To sum up, the overall picture of the operation of Calder Hall is that of a plant which, in spite of its pioneering nature, has gone into operation smoothly and satisfactorily and is fulfilling all the best hopes of its designers.

THERMO-NUCLEAR RESEARCH

While Calder Hall is in operation and three new stations employing similar principles are about to be constructed, more advanced forms of reactor based on nuclear fission are being studied. But beyond these lie the tremendous possibilities of nuclear fusion as a source of heat and power as we are reminded by an official announcement made last week.

In October last a party of scientists from Harwell visited the United States to discuss work in the thermo-nuclear field and soon after a return visit was made by American scientists to Harwell and to the A.E.I. laboratories where work is being done under contract for the Atomic Energy Authority. Now an agreement has been reached for co-operation on the civil uses of atomic energy between the United States and United Kingdom Governments and an exchange of both "classified" and "unclassified" information on research in controlled thermo-nuclear reactions has been arranged.

About ten British scientists are to take part in a "classified" conference on the subject, which has been organised by the United States Atomic Energy Commission at Berkeley, California, later this month.

BACKGROUND OF CIVILISATION

The serious consequences of a tendency, still prevalent, to regard "the humanities" as having a higher cultural value than science and engineering formed the theme of the Graham Clark Lecture delivered last week at the Institution of Electrical Engineers by Sir Ifor Evans and reported in this issue (page 299). This attitude appears to stem in part from the outlook of the Middle Ages, when a ripe classical culture could be contrasted with a primitive knowledge of science which then largely consisted of deduction from observed or misunderstood workings of nature. In its main concentration on the literary aspects of past civilisations, the fact that many of the greatest minds were profoundly interested in the causes of and the possibilities inherent in natural phenomena was forgotten.

To-day it should be readily recognised that science and technology are "a developing adventure of thought" that brings them on to the plane of fundamental subjects for the teaching of which the universities were established. On the other hand, Sir Ifor emphasised the need for maintaining a longer term balance between the two cultural aspects however urgent the present need for technical progress.

MANUFACTURING POWERS

Other sections of the industry will approve Mr. G. Nabarro's endeavour to deprive the proposed Central Electricity Generating Board of the manufacturing powers which the new Electricity Bill (like the 1947 Act) seeks to confer upon it. Mr. Maudling, the Paymaster General, pointed out that the Central Electricity Authority has never exercised the powers it possesses to manufacture plant and "fittings" ("fittings" are cut out in the new Bill) but the apprehensions we expressed when the 1947 measure was on the stocks and when it became law still remain.

These fears, which are shared by the electrical manufacturing industry (and should be shared by a Conservative Government), were summarised in our issue of 2nd April, 1948, and may be repeated:—

> "It would not be so simple for the Authority and Boards to embark upon the manufacture of equipment as it would be for them to set up installation departments and to sell appliances. All the same, the threat is there and could conceivably be used to compel manufacturers to cut their prices to below reasonable levels. In this case the possible ill-effects would not be confined to this country; to keep going, the manufacturers would be compelled to seek compensation from the export trade. But already British prices are considered to be high enough and any rise would prevent our competing in overseas markets."

PATIENCE EXHAUSTED

On page 292 we summarise the contents of a pamphlet published by the Electrical Power Engineers' Association setting forth its case for better salaries for its members and expressing its exasperation at the inadequacy of the offer made by the Central Electricity Authority and Electricity Boards in response to its claim after "months of patient discussion."

Quoting the report of the Herbert Committee in support of its contention that present salaries are too low to attract and retain the best class of engineer, the Association reflects on the possible dire consequences of this upon the efficiency of the service. The pamphlet closes with an announcement that as the protracted discussions have failed to establish a basis for prospective agreement the Association has decided to withdraw from the discussions and seek other methods of securing its objects. There is a sinister note in its final statement that the pamphlet has been issued "so that the public will understand any future action to which we may reluctantly be driven."

Resistance Welding Techniques

Electrical Review 15 *February* 1957

[*Courtesy, Handley Page, Ltd.*

Their Application as Aids to Production

By C. A. BURTON, M.Inst.W.*

MUCH has been written in the past few years on the subject of resistance welding techniques as applied to the production of aircraft, jet engines, railway carriages, motor car bodies, refrigerators, cookers and a host of other smaller assemblies, but the British engineering industry could take much greater advantage of these proven automatic processes now that automation is the keynote of production cost reduction.

An important factor influencing the selection of any welding technique for a given operation is the ultimate labour cost which is derived from a computation of the hourly production and wage rate. It invariably follows that the use of resistance welding, where applicable, will frequently show a considerable cost saving because of the lower hourly rate of unskilled machine operatives. The cost of power used by single-phase machines is not difficult to ascertain and can most easily be explained by the following example:—

A 75 kVA spot welding machine giving 50 welds per minute, each of 5 cycles duration, demands a primary current of 200 A. The supply voltage is 400 and the transformer power factor is 50 per cent. The kVA is therefore 80 and at 50 per cent power factor this represents 40 kW. As the total primary current flow time, based on the above speed of operation, is 1/12 hr per hour, the kWh consumption is $40 \times 1/12 = 3{\cdot}33$ kWh per hour.

Measurement of power consumption solely by watt-hour meter is not adequate when the electrical equipment has an inherently low power factor, as in the case of single-phase resistance welding plant. The watt-hour meter would register the same value when metering a load drawn by a deep throat spot welder, which may have a power factor as low as 25 per cent, as in the case of a similar plant with unity power factor. In the latter case, however, only 25 per cent of the generating, transmission and distribution installations would be required.

To supplement the kWh energy charge, the maximum demand system is widely used, frequently based on half-hour periods. With this method, resistance welding plant having a low duty cycle, as intermittently operating spot welders and flash welders, would not have much influence on the maximum demand, whereas equipment working at considerably greater rates of production may influence the maximum demand recording materially.

As a general rule, however, power costs per component welded are extremely low indeed and these conditions are further bettered by the installation of three-phase balanced load resistance welding machines where power is drawn from the three supply lines at near unity power factor.

Before describing how the process has been applied to increase the production of a number of representative components we should first consider why this process should be selected and what advantages can be gained by the use of resistance welding instead of one of the many alternative fastening methods.

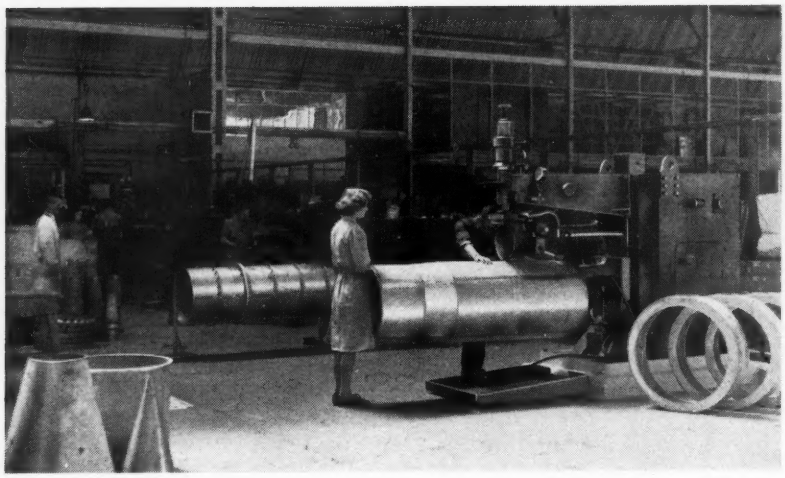
Advantages of Process

The first and one of the most important factors is the elimination of added materials such as rivets, filler rods, fluxes, spelter, etc. The very high production rates achieved on automatic resistance welding plant, together with the use of unskilled or semi-skilled labour for machine operation, is another important advantage. In addition to these very definite savings, and since no additional extraneous filler material is used, the weld metallurgy is much less complicated and the original properties of the parent sheet materials are less disturbed than in the case of fusion welding. Air hardening steels and materials which have a carbon content in excess of 0·25 per cent will be affected by resistance welding, but the application of automatic preheat and post-heat treatments will restore the original material properties.

The superior surface finish of the spot, roll-spot or seam-welded joint, together with the high production rate, is frequently the reason why these processes are preferred. Owing to the extremely localised heated zone, resistance welding is carried out with the minimum of distortion.

The cost of resistance welding plant and its installation depends to a great extent on the rate at which the welded component parts are to be produced and this factor must be considered when assessing the final cost of the

* Mr. Burton is technical sales manager of Sciaky Electric Welding Machines, Ltd.



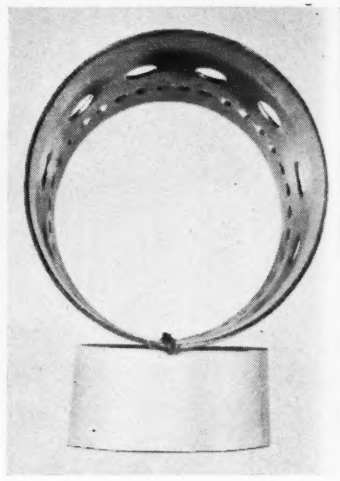


Fig. 1 (left).—Fabrication of jet pipes by resistance seam welding (de Havilland Engine Co., Ltd.). Fig. 2 (right).—Inner combustion chamber of American J-57 turbo-jet engine; components made from Nimonic 75 material (Sciaky Bros., Inc.)

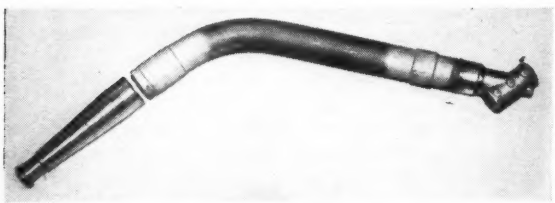


Fig. 3.—Partially flash welded landing gear components (Sciaky Bros., Inc.)

operation. As an example, general purpose spot welding machines of the lower capacity can be purchased from £175 upwards and, depending on the type and degree of use, should be written off over a period of from 7 to 15 years. On the other hand, specially developed multi-spot welding machines such as those in use in the motor body industries are often amortised during the production run of the specific job. In some cases, however, the life can be considerably extended by designing the complete tooling, including welding transformers, pressure cylinder assemblies and associated equipment, for interchangeability, within the upstroke press. Thus, when the batch run of welded components has been completed, the composite tooling is changed for an entirely different set and the machine recommences a new batch run.

It is now proposed to describe some of the comparatively recent developments which have taken place in the employment of resistance welding processes in certain specific industries and not only British ones. An analysis of these examples will show how resistance welding in one or several of its various forms can be still further exploited to produce a quality product at the lowest possible cost.

The Aircraft Industry

Spot, stitch, roll-spot and seam welding of gas turbine canware involving such materials as 18/8 stainless steel, Nimonic 75/90, Fortiweld, etc., has been carried out extensively in most countries for many years and there is no doubt that the rapid development of the jet engine was made possible by this process. As the approximate maximum working temperature of flame tubes is of the order of 750 deg C, the welding is subjected to considerable thermal stresses in addition to alternating stresses caused by pulsations of varying frequencies and magnitude in the air stream. Where such components as the exhaust unit and jet pipe are concerned weld-decay-free austenitic stainless steel is used, as these parts operate at somewhat lower temperatures. Fig. 1 illustrates seam welding being carried out on the jet pipe assemblies.

As the reliability and freedom of service failure of resistance-welded joints in the turbo-jet engine are well known, it is proposed to outline several other resistance welding applications which have not yet been developed to any great extent in this country.

Flash-butt Welding Sheet Metal Assemblies

In America, the flash-butt welding process is now being extensively applied to sheet metal assemblies in the turbo-jet engine to obtain an additional weight saving. Fig. 2 illustrates the inner combustion chamber of the J-57 turbo-jet engine. This truncated cone section is approximately 2·4in minor diameter and 2·9in major diameter and approximately 2·2in long. The piece is manufactured from 0·050in thick Nimonic 75 alloy and is first blanked from sheet stock at which time the holes for admitting compressed air are pierced. It is then rolled to its circular shape and flash-butt welded. The flash is trimmed automatically and the part given a final sizing operation in the expanding die. The distance between the pre-punched holes is held within close tolerances by the flash-butt welding process.

From statistics available this process can be compared with the fabrication of the same component by Heliarc welding. With the longitudinal joint fusion welded, the production time was 1·5 min per part. The cost of inert gas and consumable electrode per piece was approximately 2·5 cents. The flash-butt welding time was approximately 0·35 min per part and no shielding gas or consumable electrodes were used. The present trend in the manufacture of the supporting rings of the jet engine is to preform the bar stock close to its final shape and then roll it into a ring and subsequently flash-butt weld it.

Flash-butt welding is also used in American aircraft construction for fabricating alloy steel engine mountings, landing gear, arresting gear for carrier-based aircraft and control rods, and the ultimate strength of these assemblies will be equal to that of a similar part manufactured from one piece of metal. Fig. 3 illustrates a landing gear

structure component partly welded. This unit is made from chrome-molybdenum steel 3in o/d and ratio of the o/d to the wall thickness is 41:1.

It has already been proved that the major advantages of flash-butt welding are weight saving, reliability, design simplicity, economy and ease of quality control; and although performance improvement is the determining factor in the selection of resistance welding for fabricating airframe and jet engine structural components, the resultant saving in costs represents an additional advantage.

Spot Welding of Airframe Structures

The use of spot and roll-spot welding of heat-treatable light alloys in primary and secondary airframe structures is now an established process both in this country and in America, although American aircraft manufacturers have accumulated considerably more experience in this field as they had an earlier opportunity to gather performance data from the thousands of aircraft manufactured by them during the war. Resulting from this, the reliability of the spot welded joint was proved beyond question.

Spot welding and its associated process, roll-spot welding, contributes to aircraft performance in three ways:—(*a*) It reduces the airframe weight; (*b*) it reduces or eliminates the sealing problem; and (*c*) it reduces parasitic drag.

The airframe weight is reduced because a given load carried by a splice joint fabrication by spot welding allows a reduced sheet overlap and occasionally permits a reduction of the skin thickness. Furthermore, local load concentrations can be effectively dealt with by providing doublers spot or roll-spot welded to the skins in the required positions. Flush riveting such doublers is frequently impracticable, because of the large number of rivets required in a relatively small area.

It is necessary to pressure-seal the major portion of the places from which the internal pressurised atmosphere may escape from the fuselage, and this is carried out on riveted structures by the application of sealing compounds to the stringer-plate interface as well as around the upset head of each rivet. As a contrast, no sealing compound is required if the stringer is fastened by spot or roll-spot welding.

An external surface joined to stiffeners, doublers, etc., by spot welding results in an aerodynamically smoother surface than when flush rivets are used and allows improved matching up at joints compared to similar riveted assemblies.

When the three major advantages outlined above are considered in conjunction with the proved fact that substantial cost savings can be achieved by resistance spot, roll-spot and seam welding techniques when compared with any other fabrication method, it is not surprising that many American aircraft containing in some cases over two million spot welds and with 18,000 flying hours to their credit, are now commonplace.

In this country the first company to design a civil aircraft in which spot welding is one of the principal methods used for joining components of primary structures, is Handley Page, Ltd. The " Herald," a four-engined high wing aircraft, is designed to seat 44 passengers and it has well over 100,000 spot welds in its wings and fuselage construction. In the " Victor " bomber produced by the same company spot welded sandwich construction is extensively used. The company's experience of this process extends over sixteen years and in that time well over four million quality controlled spot welds have been made, which from subsequent service experience obtained, has shown that spot welds are more trouble free than riveted construction. The more recent installation of three-phase frequency conversion " Modu-wave " seam and roll-spot welding machines has now resulted in spot welds being produced at the rate of 90 welds per minute per machine. Fig. 4 illustrates a 300 kVA three-phase balanced load frequency conversion seam and roll-spot welding machine for welding up to 0·104in+0·104in heat-treatable aluminium alloy.

It seems highly probable that military aircraft of the future will be designed to incorporate airframes fabricated

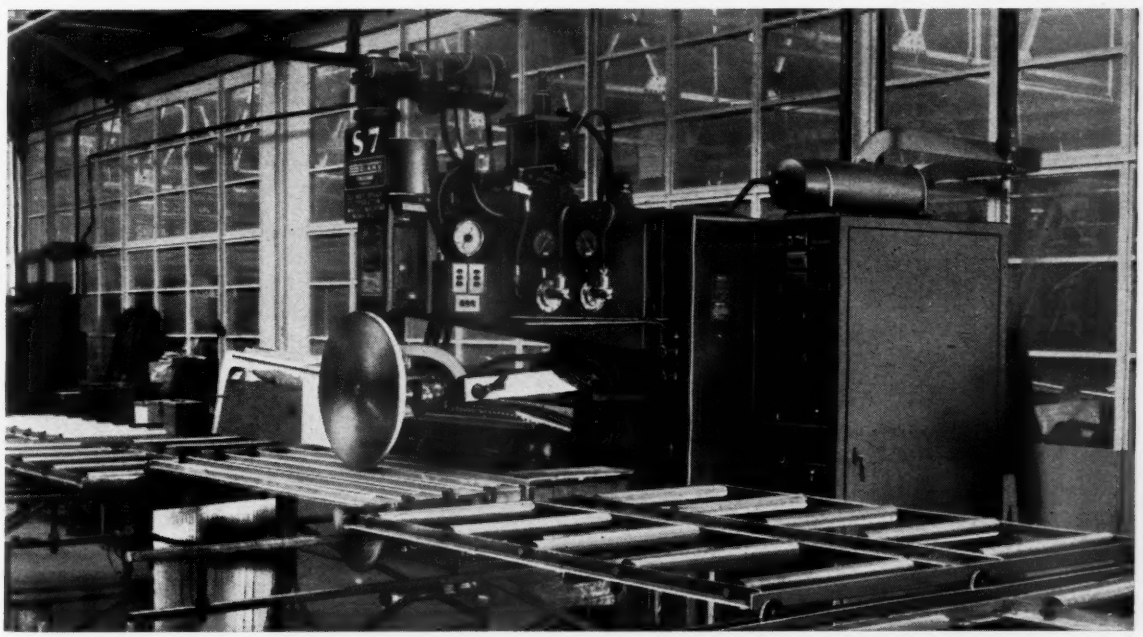


Fig. 4.—300 kVA three-phase seam and roll-spot welding machine for light alloy welding of primary structures (Handley Page, Ltd.)

Fig. 5

Fig. 6

Fig. 5.—View of workshop engaged on production of light alloy spot welded roofs for goods wagons (A.N.F.)

Fig. 6.—Sliding light alloy roof assembly, spot welded (A.N.F.)

Fig. 7.—Portable spot welding of light alloy goods wagon roof (A.N.F.)

Fig. 8.—Portable spot welding of stainless steel railway carriage floor (Sorefame)

Fig. 7

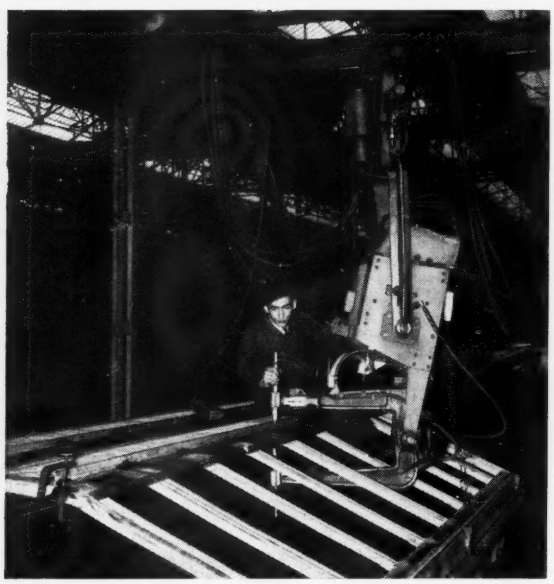
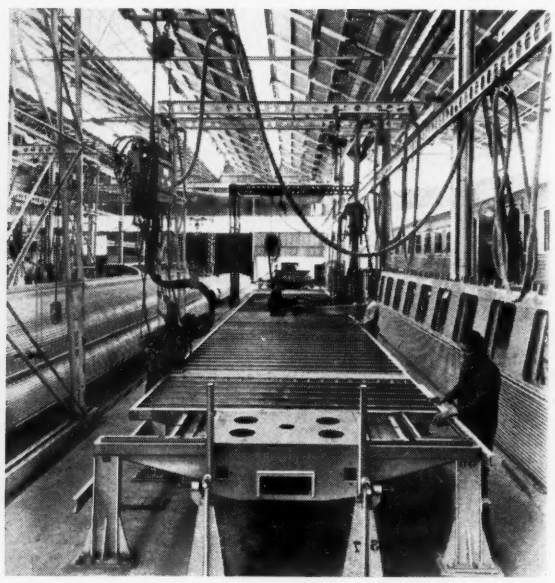


Fig. 8



in heat and corrosion resistant alloys to overcome the effects of breaking the thermal barrier and, undoubtedly, aircraft designers will again use resistance welding as the major joining method.

Railway Applications

The first important application of resistance welding in the construction of railway rolling stock was made on the Continent by the Chemins de Fer du Nord in 1928, when an experimental machine was designed by Sciaky S.A., of Paris. As a result of this pioneering work sufficient data were obtained to justify the development of this method of fabrication. Since then, resistance welding has been used extensively by French, German, Spanish and Italian companies for the production of passenger carriages, auto-cars and goods wagons, using a variety of materials, including low carbon steel, special steel alloys, stainless steels and light alloys.

The following major advantages are claimed for this method of welding:—

(1) Considerable reduction in deformation and distortion in the plating of the assemblies.

(2) Weight reduction achieved by the elimination of rivet heads or added materials.

(3) Joints produced by riveting are not water- or air-tight and therefore protective coatings have to be provided. Resistance-welded assemblies are in themselves pressure-tight.

(4) The exterior surface finish of spot-welded assemblies is superior to riveted assemblies.

(5) In practice, it has been proved that the speed of spot welding varies between 240 and 1,200 welds per hour as compared with speeds of the order of 120 rivets per hour with good quality riveting.

Fig. 5 shows the production of roofs for goods wagons as carried out by Ateliers de Construction du Nord de la France (A.N.F.). The roof system is designed for two half-roofs per wagon, one half-section sliding over the other to facilitate crane loading and unloading (Fig. 6). The material used is "Almasilium" and the bulk of the welding is carried out on the Sciaky three-phase pedestal type spot welder, components such as the middle sheet assemblies being welded on a portable single-phase machine (Fig. 7). Each half-roof section is fabricated by 1,530 spot welds made at an average speed of between 20 and 40 welds per minute and the production rate achieved is seven half-roofs every eight hours, including maintenance.

Another example of the extensive use of resistance welding in the Continental railway industry is exemplified by Sorefame, with a modern factory situated near Lisbon. This company manufactures stainless steel railway carriages under the Budd licence and it makes extensive use of spot welding. At the present time, eight complete coach bodies are produced per month varying between third class carriages and rail-cars. The use of 17 per cent Cr and 7 per cent Ni stainless steel reduces the risk of corrosion and simplifies the maintenance of the coaches. The high strength of this material permits the use of lesser thicknesses than would be the case if mild steel were used, and this results in weight reduction and greater economy of tractive effort.

Fig. 8 shows spot welding being carried out on the carriage floor whilst to the left and right of this section can be seen the roof and sides of the same carriage respectively. Fig. 9 shows a completed stainless steel coach, embodying approximately 136,000 spot welds. Resistance welding plant used on this outstanding project was designed and supplied by Sciaky S.A. Fig. 10 illustrates a spot-welded three-coach train in service on the French northern railway network. The three articulated cars are fabricated by 180,000 spot welds.

The development of the use of resistance welding on British rolling stock is now under way and it is possible that in a short time British manufacturers will be producing resistance-welded coaches.

Motor Car Industry

The use of all-resistance-welding techniques in the automobile industry has been common for many years and there is no doubt that portable spot welders have resulted in very high body production rates at extremely low cost. To keep pace with the automation trend, the car industry has, for some time, been installing multi-spot welders which are designed for producing large numbers of spot welds simultaneously or in automatic sequence. Such machines materially save labour costs and automatically reproduce identical components.

A typical example of such plant is shown in Fig. 11. This is referred to as a permutation welder as it has been designed to obtain the advantages of multi-electrode machines for comparatively small scale production without the high initial cost of the upstroke press multiple

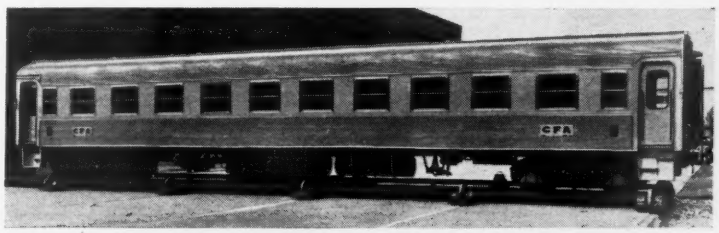
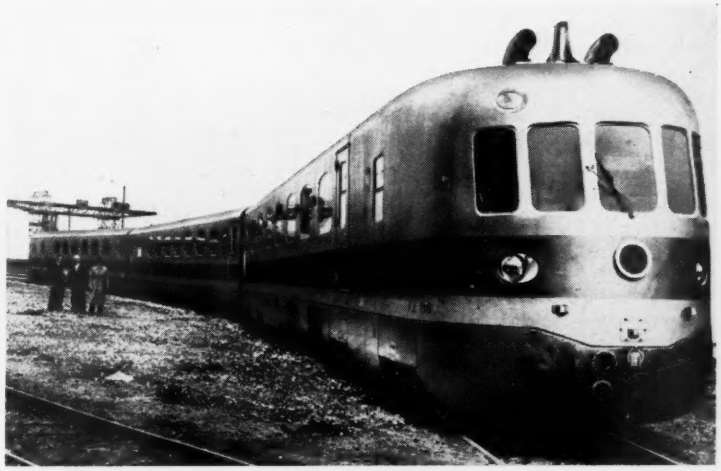


Fig. 9.—View of spot welded stainless steel railway coach, approximately 136,000 spot welds (Sorefame)

Fig. 10.—Three-coach articulated train, fabricated by 180,000 spot welds (Compagnie Franco-Belge)



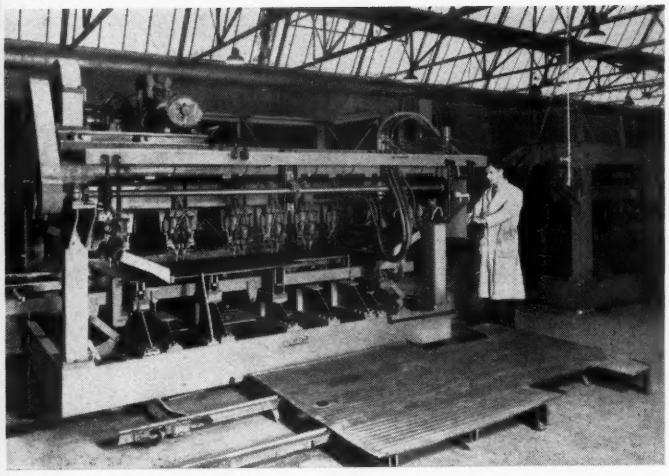


Fig. 11.—Multi-spot permutation welder, for fabrication of commercial vehicle floors (Sciaky Electric Welding Machines)

set-ups. For this particular application it was necessary to spot weld a mild steel floor to its chassis, for the production of a commercial vehicle. Two machines were produced, one to make approximately 204 welds between the longitudinal members and the floor panel, and the other to make 310 welds between the chassis cross members and the floor. As both units are operating at the same time, the production schedule works out at twelve assemblies per hour. A heavy fabricated mild steel beam, to which are fitted six transformers, and twelve air operated welding heads, traverses the width of the floor in 38 sequences, at increments of $1\frac{3}{4}$in, the indexing being carried out by a Geneva gearing system. At each stationary position of the beam, twelve series welds are produced.

Shock Absorber Assemblies

Fig. 12 shows two typical shock absorber units fabricated entirely by resistance welding. The studs and rings are projection welded to the end caps, which are seam welded to the shock absorber tubes. This operation is carried out on a machine illustrated in Fig. 13. The tooling fitted to the front of the machine is adjustable to take various shock absorber lengths. To complete the fabrication of this component, the final sealing has to be carried out with the shock absorber filled with oil. This can only be done vertically, and the components are placed in a machine in which the two electrode wheels are in a horizontal plane and apply welding pressure in the correct position on the tube.

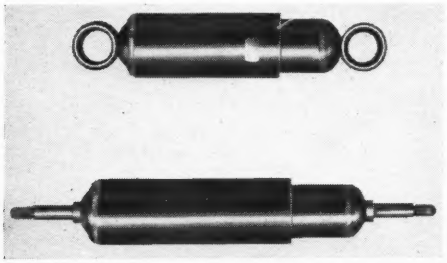


Fig. 12.—View of completely resistance welded shock absorber assemblies (Woodhead-Monroe)

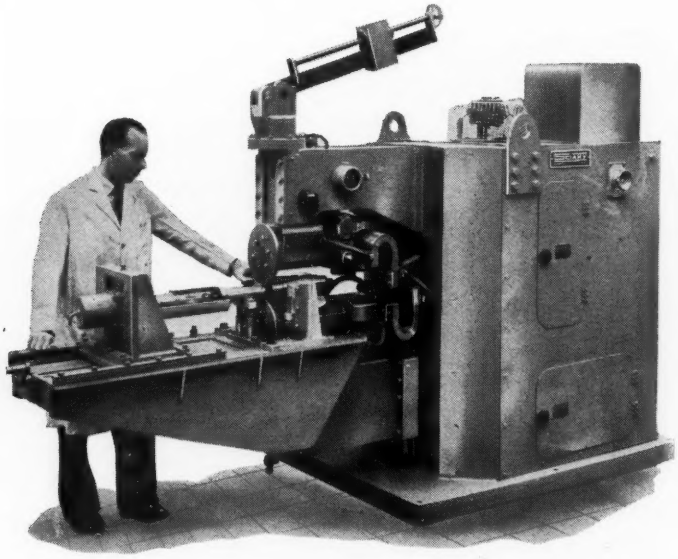


Fig. 13.—Resistance seam welding operation carried out on shock absorber assemblies (Sciaky Electric Welding Machines)

"Glove Box" Symposium at Harwell

A THREE-DAY symposium on "Glove Box Design and Operation" is being held next week at the Atomic Energy Research Establishment, Harwell (19th to 21st February). Among those invited to participate are research workers from universities, representatives of interested industrial firms and delegates from overseas atomic energy organisations. The symposium will cover the design and operation of both shielded and unshielded glove boxes, and during the conference delegates will be invited to tour typical installations in the chemical and metallurgical laboratories at Harwell.

A "glove box" is a sealed box in which highly toxic materials can be safely handled. The boxes must therefore be designed to prevent leakage of the inside atmosphere into the laboratory air and yet to permit ordinary chemical and metallurgical operations inside it. If there is no penetrating radiation emitted from the materials handled then the operations can be performed through gloves sealed into the side of the box (unshielded box). If the material handled is not only highly toxic but also emits penetrating radiation, then the box must be surrounded by a lead or concrete shield through which remote handling tongs can be operated.

The need for a symposium on this branch of remote handling technique stems from the very rapid technical developments in this field during the last few years and from the importance of glove box methods in the development of power reactor technology. Papers on the general design of shielded and unshielded boxes, on their installation and maintenance and on their applications to chemical, metallurgical and large-scale operations will be among those to be presented. The detailed proceedings will be published in due course.

POWER FACTOR CORRECTION

By H. K. HADLEY, A.M.S.E.*

The Use of Static Condensers and the Effect of Over-Correction

A CHARACTERISTIC of certain classes of electrical alternating-current equipment is an inherently low power factor, resulting in more current being drawn from the supply lines than is usefully used. For example, the standard induction motor of good design and running on full load may have a power factor of 0·85 lagging; in other words 15 per cent of the current drawn from the supply is ineffective. This condition is often aggravated by a tendency to over-estimate the power requirements for a particular application. The result is that the induction motor may be running on three-quarter load or even less. The power factor may then fall to 0·8 lagging, so that 20 per cent of the current taken will be ineffective.

The power factor of a works installation is, therefore, something which concerns consumer and supply authority alike, since the nearer the power factor approaches unity, the better the return on capital invested in supply cables and apparatus, and the lower the current metered to give the same service. There are, however, economic, electrical, and mechanical limitations to take into account in determining the amount of correction undertaken, and a compromise can be resolved from the following considerations.

It is in the interests of the supply authority to correct the apparatus (feeders, transformers, etc.) up to the consumers' premises. The method adopted by the consumer for correcting low power factor necessarily depends upon the amount of power involved, whether the inductive loads are scattered, or in one small area, and the extent to which the supply authority will assist in correction.

Power factor correction may be carried out by means of rotary condensers, phase advancers, static condensers, or a combination of these methods. Rotating machinery is usually employed by supply undertakings and large consumers, while static condensers are mostly used by small and moderate size consumers. The British Thomson-Houston Co., Ltd., manufactures a range of corrective plant of the rotary type, including synchronous condensers, several types of synchronous motor, and also "No-Lag" motors designed for use at unity and leading power factors.

In this article a practical approach to power factor correction by means of static condensers is presented, having in mind the smaller consumer employing induction motors, none of which is large enough to warrant replacement by a rotating power factor correcting machine. The effect of over-correction is also considered, as this danger is often overlooked.

Effect of Power Factor

The power factor of an induction motor is seldom greater than 0·9 lagging, and may be considerably less on machines having a large number of poles. It is well known that the main reason for the low power factor of induction motors is that their magnetising current which is in quadrature (lagging) with the voltage, must be supplied from the a.c. line; in this respect induction motors differ from synchronous machines in which the magnetising current is supplied as d.c., and therefore does not lower the power factor of the a.c. input. The advantage of improving the power factor will be readily appreciated from the following considerations.

A 50 h.p. motor, power factor 0·8, efficiency 85 per cent, operates on a 400 V, 50 c/s, three-phase supply.

$$\text{Full load amps} = \frac{50 \times 746 \times 100}{\sqrt{3} \times 400 \times 0{\cdot}8 \times 85} = 79$$

$$\text{kVA input} = \frac{\sqrt{3}\,\text{VI}}{1000} = \frac{\sqrt{3} \times 400 \times 79}{1000} = 54{\cdot}7.$$

If the power factor was improved to say 0·95, the full load current would be reduced to 66·5 A, and the kVA input to 46. Thus the kVA demand is reduced, and also the loading on the supply cables. The heating loss produced in the conductors of cables depends upon the square of the current; thus if a portion of the circuit has a resistance R, the heating loss in watts for a transmitted power P, is given by

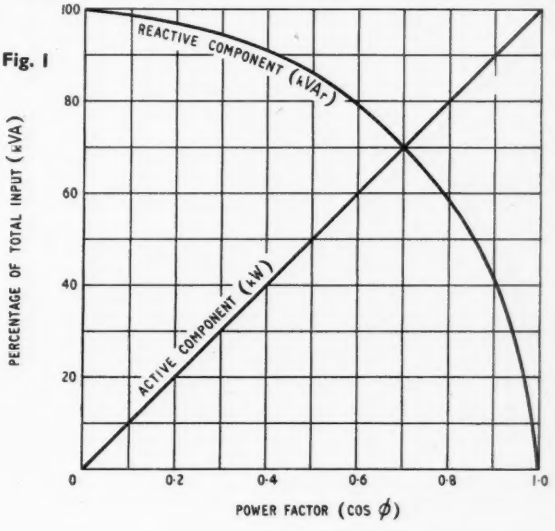
$\left(\frac{P}{V \cos\phi}\right)^2 R$ for single-phase, or $\left(\frac{P}{\sqrt{3}\,V \cos\phi}\right)^2 R$ for three-phase.

In both cases this loss $\propto P^2/\cos^2\phi$, so the heating loss is inversely proportional to the *square* of the power factor. Looking at it another way, for a given permissible copper loss, the power utilised will be directly proportional to the power factor, so that as the power factor decreases, the power which can be handled by a given conductor will decrease correspondingly.

Economic Limit of Correction

The active component as a percentage of the total kVA is directly proportional to the power factor and is, therefore, represented by a straight line. The reactive component is proportional to sin ϕ and, when plotted against power factor, gives a curve which is a quadrant of a circle. These curves are shown in Fig. 1. It will be seen

Fig. 1



* B.T.H. Industrial Machines Department.

that to improve from 0·8 to 0·95 power factor, a corrective kVAr of approximately 30 per cent of the kVA input is required. To correct to unity power factor this percentage is roughly doubled, therefore normally it is uneconomical to correct the p.f. to a much greater figure than 0·95.

The simplest method of determining the power factor is by taking a direct reading from a power factor meter which registers the phase angle between the line voltage and the line current. Where such a meter is not available, the power factor may be measured by taking input watts, line volts, and line amps., from which

$$\text{P.f. in single-phase circuit} = \frac{W}{V \times I}$$

$$\text{P.f. in two-phase (four-wire) circuit} = \frac{W}{2 \times V \times I}$$

$$\text{P.f. in three-phase circuit} = \frac{W}{\sqrt{3} \times V \times I}$$

Considering the motor mentioned in the previous example, i.e. 50 h.p., 400 V, three-phase, 50 c/s, power factor 0·8, efficiency 85 per cent, the rating of a condenser to raise the power factor to 0·95 may be obtained as follows:

$$\text{kW input} = \frac{50 \times 746}{1000} \times \frac{100}{85} = 43{\cdot}9$$

kVA input $= 43{\cdot}9 \div 0{\cdot}8 = 54{\cdot}9$

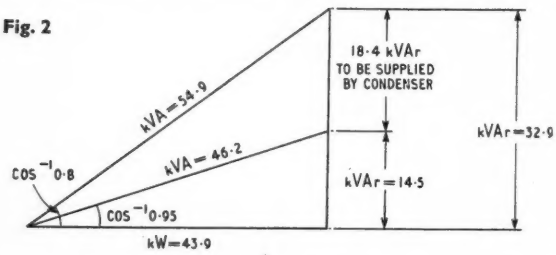
Reactive component at 0·8 p.f. $= \sqrt{54{\cdot}9^2 - 43{\cdot}9^2} = 32{\cdot}9$ kVAr.

At 0·9 p.f. kVA input $= 43{\cdot}9 \div 0{\cdot}95 = 46{\cdot}2$

Reactive component at 0·95 p.f. $= \sqrt{46{\cdot}2^2 - 43{\cdot}9^2} = 14{\cdot}5$ kVAr.

The difference between the two reactive components—$32{\cdot}9 - 14{\cdot}5 = 18{\cdot}4$ kVA is the leading reactive kVA required from the condenser to raise the power factor from 0·8 to 0·95. The vector solution is shown in Fig. 2. The corrective kVA should not exceed 85 per cent of the

Fig. 2



motor magnetising kVA; the reason for this is discussed later. If the above motor is a 12 pole machine with a synchronous speed of 500 r.p.m., then from the table provided the magnetising kVA = 22. As the condenser kVA is less than 85 per cent of this figure, this fulfils the requirements.

The total capacity of the condenser in microfarads

$$= \frac{\text{kVA} \times 10^9}{2\pi \times f \times V^2} = \frac{18{\cdot}4 \times 10^9}{2\pi \times 50 \times 400^2} = 366\,\mu\text{F}.$$

Thus for a three-phase motor, three banks of condensers, delta connected, would be required, each bank having a capacity of 122 μF.

Over-Correction

The danger of over-correction cannot be too strongly emphasised, and the effect of this is now given consideration.

Both the motor and capacitor will each draw a current whose magnitude will depend on the supply voltage. If

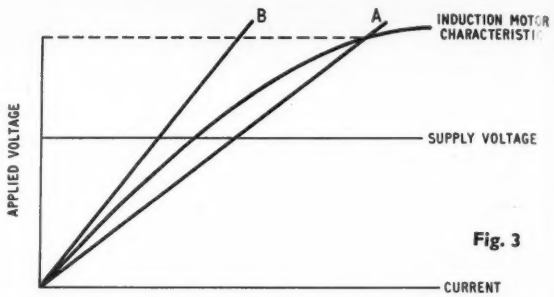


Fig. 3

the supply is interrupted, the motor will continue to rotate due to its own inertia, and possibly the load inertia. The flux and hence the back e.m.f. of the motor will not collapse instantaneously, so that the back e.m.f. will appear across the motor terminals.

With a capacitor having characteristic " A " in Fig. 3, the magnitude of the capacitor current will exceed that of the motor magnetising current, so that the flux will build up and the voltage will increase to the point where the two curves intersect. A voltage considerably higher than normal will therefore be built up each time the supply is interrupted. To avoid this condition, it is advisable to limit the capacitor kVAr to about 85 per cent of the motor magnetising kVA. It can be seen that a capacitor having characteristic " B " will fulfil this requirement.

High Inertia Drives

Even when voltages due to self-excitation do not reach excessive values, abnormal torques can occur on high inertia drives if rapid re-switching takes place. These transient torques are capable of producing severe mechanical stresses which can result in shaft breakages.

If the supply is switched off, the inertia of the load and motor will continue for a short period to drive the motor without appreciable drop in speed. If a capacitor is connected having a kVAr output equal to or greater than the magnetising kVA, then the induction motor will act as a self-excited generator as long as the speed is maintained by the inertia. If the generated voltage produced by self-excitation is near or above normal voltage, then it would be dangerous to reconnect the supply since the two voltages would most likely be out of phase. The magnitude of the electrical transient torque (value of magnetic flux across the air gap) developed in the motor will be determined by the motor voltage and the electrical angle between the supply and the motor voltage at the instant of switching. With a motor voltage equal to the supply voltage, and a corrected power factor of near unity, then at the worst switching angle (about 240 deg) it is possible for the maximum electrical torque to reach a value of more than ten times normal torque. Still higher transient torques will occur with motor voltages exceeding the normal supply voltage. It will therefore be appreciated that even if excessive voltages are not produced by over-correction, serious mechanical trouble can arise on high inertia drives due to transient torques, if rapid re-switching takes place.

Typical values of magnetising kVA for polyphase induction motors are given in the following table:—

h.p.	Synchronous Speed (r.p.m.)					
	3,000	1,500	1,000	750	600	500
5	1·6	1·7	2·1	3·0	3·6	4·0
10	2·4	3·0	3·8	4·5	5·2	6·0
15	3·4	4·0	5·4	6·2	7·0	8·0
20	4·5	5·3	7·1	8·0	8·8	9·6
30	7·2	8·0	10·5	11·6	12·5	13·6
40	10·0	10·5	14·3	15·4	16·7	18·0
50	12·8	13·2	17·0	18·0	20·0	22·0

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

CASES of automatic recovery of synchronism by the generators after temporary loss of stability in power systems have been observed fairly frequently and the knowledge of the conditions under which synchronism will be automatically restored is important for the operation of power systems. The investigation presented is based on the theory of non-linear oscillations and consideration of the phase trajectories, obtained by numerical integration methods. These phase trajectories are slip-phase angle relations of spiral character, asymptotically approaching the equilibrium point or steady focus, corresponding to equality between the turbine torque and synchronising moment of the generator.

The analysis of the sets of phase trajectories obtained, known as the " phase portrait " of the system, shows that recovery of synchronism is conditional upon strong coupling between power station and system, e.g. for the usual values of the coefficient of non-uniformity of the turbine regulator, viz. 4 to 5 per cent, recovery of synchronism is possible only for a ratio of generator output to transmitting capacity of the line $P_o/P \geqslant_{max} 0{\cdot}30$-$0{\cdot}33$. This applies only to the case in which system frequency is maintained, otherwise the conditions are even more severe. However, it is easy to improve the tendency to self-synchronisation by various methods, particularly improvement (reduction) of the coefficient of non-uniformity of the regulator, use of load-shedding controlled by frequency, etc.—" Conditions of Restoring Synchronism after a Loss of Stability," V. M. Gornshtein, *Elektrichestvo*, No. 10, pp. 12-18, 1956, in Russian.

Cable Loadings

It is quite often the case that cables, and even whole bundles of them, have to run along hot walls, plates and pipe lines, or else to rise along masts and be exposed to sunlight. This will obviously raise their temperature above that due to current flow, so that the loading of the cables must be reduced to keep them within the permissible temperature. However, this case is not considered by existing regulations, so that the appropriate reduction factors for the loading have to be determined in every case individually. Also, in bad cases, a reflecting cable sheath (either painted white, or wrapped in aluminium foil) may have to be used, although this method has the inherent disadvantage that though less heat is absorbed less is also removed by radiation from the cable.

The problem of determining the load reduction factors is solved by the author, as well as when it is necessary to use white cables instead of black ones. Belted and SL-cables have to be treated separately in this respect. It is found that there is a critical intensity of radiation which can be represented as a function of the cable diameter, with the operating voltage as a parameter. This enables the reduction factor to be graphed as a function of the cable diameter, with the radiation intensity as a parameter. Another graph, combined with a table of the emission coefficients of the most important materials, enables the radiation intensities to be introduced into the formulæ of the reduction factors to be quickly determined. —" Permissible Loading of a Cable Exposed to Strong Heat Radiation," L. Geiling, *Siemens-Z.*, Vol. 30, No. 9, pp. 469-473, September, 1956, in German.

Protection Circuit Relays

The advantages of using magneto-electric and polarised relays combined with full-wave rectifiers in protection circuits are as follows: (*a*) characteristics either analogous to those of electromagnetic and induction relays, or others obtainable only with difficulty from such relays (elliptic, hyperbolic, broken-plot type, etc.) are conveniently obtained from these combined relays; (*b*) response of protection remains reliable at small values of the currents and voltages fed to the relays; (*c*) the small power consumption of combined relays simplifies design and construction of the auxiliaries required (intermediate transformers, symmetrical component networks, filters, etc.) improves operating conditions of instrument transformers and enables operating a.c. to be used for relay actuation; (*d*) protection systems in which the measuring element requires not more than 1-2 cycles for operation to become possible; (*e*) full-wave rectification and the possible integration (summation) of the rectified electrical quantities enables single-system starting and measuring elements to be used; (*f*) greater simplicity and economy of the protection systems in general. Against this has to be set the drawback of the non-linearity of the VA characteristic of the semiconductor-type rectifiers and the harmonics in the rectified current which has to be considered in the design of such protection systems. The development is definitely very promising.—" Use of Magneto-Electric and Polarised Relays in Relay Protection Circuits," G. I. Atabekov, *Elektrichestvo*, No. 7, pp. 29-36, 1956, in Russian.

Surge Testing

Although the theoretical precision of oscillographic equipment for surge testing is of the order of ± 1 per cent, it is well known that this is not usually achieved in practical surge tests, least of all in batch tests. Furthermore, the method in itself is wasteful of time and complete oscillograms are mostly not required, but only two characteristic values, which have to be found by evaluation of the oscillograms. A good alternative is an electronic circuit with a "univibrator" time-measuring or, more accurately, " timing " circuit, which may be used for a rapid performance of the most important measurements in surge testing, including, or exclusive of, S characteristics.

It is not claimed that the errors in the measurements with this equipment are smaller than those incurred by the use of oscillographs, but the error sources are different, so that the combination of measurements by both types of apparatus offers a convenient check of the data provided by either method. Although the stepwise measurement of points of surge characteristics by means of retarding lines still represents a problem not fully solved, there are reasons to assume that the method compares favourably with the performance of oscillographs.—" Surge Testing Without Oscillograph," J. Hajek, *Elektrotech. Obzor*, Vol. 45, No. 12, pp. 617-621, 1956, in Czech.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates. — Editors, *Electrical Review*.

ELECTRICITY BILL IN COMMITTEE

Generating Board's Manufacturing Powers

IN last week's issue we gave a brief report of the first day's proceedings of the Standing Committee of the House of Commons on the Electricity Bill. In the course of the discussion Sir Frank Soskice said that the Government should give a fuller explanation of the reason for changing the vesting date from 1st April, 1958, to 1st January, 1958. Mr. Nabarro approved the change which, he said, would reduce the period of uncertainty among the senior staff of the industry.

Mr. Palmer said that there were many questions to be asked about the exact responsibilities of Ministers and about the relationships between the proposed Electricity Council and Central Electricity Generating Board and between these and the Atomic Energy Authority, which was still mainly the responsibility of the Lord President of the Council. No doubt some of the employees of the Central Electricity Authority would be taken over by the new bodies but where would the administrative people go? Mr. Palmer suggested that the chairman of the Electricity Council should be given the task of preliminary planning.

Replying to these and other questions Mr. R. Maudling, Paymaster General, who is in charge of the Bill in the Commons, said that the Government wished to reduce the period of uncertainty for the employees. He pointed out that it would be left to the Electricity Council to decide whether its financial year should coincide with the calendar year or whether it should remain as at present.

During the discussion on the motion that Clause 1 should stand part of the Bill Mr. Warbey and Mr. Palmer both expressed the view that the Minister should have given credit to the C.E.A. for the excellent work which it had done. Other Opposition speakers deprecated the proposed weakening of the powers of the central body. In his reply Mr. Maudling paid a tribute to the work of Lord Citrine and his colleagues.

Mr. Maudling promised that an amendment would be put down providing that large users of electricity could obtain supplies directly from the Central Generating Board. Mr. Palmer objected to this when, he said, the Area Boards were to be required to pay their own way. By this arrangement they might lose remunerative business. Mr. Maudling said that he would consider the matters raised and pointed out that Ministerial permission would always be required.

Deletion Moved

The whole of the proceedings at the second sitting of the Committee were devoted to an amendment moved by Mr. Nabarro to delete from Clause 2 the power of the Central Electricity Generating Board to manufacture generating plant, except for the purpose of experiment or research. He said that under the 1947 Act the nationalised industry had the power to manufacture both electrical plant and fittings, provided they were not for export. In this Bill it was curious that the Government, while stripping the industry of the right to make fittings, left the Board with the power to make plant.

One of the reasons why this power was given in 1947 was that the C.E.A. might need it to counter any monopolistic tendencies on the part of plant manufacturers. But the Government had passed the Restrictive Trade Practices Act, 1956, which gave exactly the safeguards which were needed.

It was a pity that the report of the Monopolies Commission, which had investigated the practices of the heavy electrical plant manufacturers, was not available yet to help the Committee.

Industry's Success in Export Field

In the export drive, said Mr. Nabarro, it was significant that the industry was the only one which had successfully penetrated and maintained sales in the American market. Irrespective of party politics he was certain the Committee would congratulate the English Electric Co. on capturing the contract for the Chief Joseph Dam in spite of competition from American and German makers, the import tariff, and in spite of the U.S. Army Department. This was achieved for a variety of reasons, technical excellence and highly developed design being among them, but the dominant factor was simply that the base carrying the heavy costs in the industry was a continuous and well-established home market. Only the C.E.A. purchased this class of plant and it followed that firms like English Electric, British Thomson-Houston, Metropolitan Vickers, Babcock & Wilcox and B.I. Callender's Cables were only able to quote keen and competitive prices in the export markets if they continued to enjoy the benefits of a stable and continuous home market demand. Its loss would have a detrimental effect on export prices and damage their prospects of competitive tendering.

The Government might protest that a Conservative Minister of Power would never authorise the Board to begin manufacturing but it should be written into the Bill to take care of the long-term situation. If the first amendment was not accepted he would seek to move another which would place certain safeguards on the powers of the Minister to ensure that before the Board was allowed to manufacture plant it could be questioned by Parliament.

Mr. Eric Johnson seconded, and Mr. R. L. Mawby, supporting the amendment, said that there was still a shortage of labour in the electrical industry and if the Board started manufacturing it would certainly be attracting away men who were already making plant anyway. The Government must also take into account that much capital and material had been sunk in increasing the production of generating sets for the nuclear power programme.

Mr. Palmer said he hoped it would not be overlooked that a public authority produced the first reactor.

Mr. Mawby said there had been a very happy alliance between the A.E.A. and private firms. His point was that if the Government believed that nationalisation of the generating equipment industry was a good thing, they should say so, and not give an opportunity for nationalisation by opening the back door so that the Board could enter into unfair competition with the industry. The export markets were maintained to a large extent because all over the world we had engineers in power stations who were cradled and nurtured on the premises of the British manufacturers.

The Paymaster General, Mr. Maudling, pointed out

that the power to manufacture was possessed by the old private power companies when they were taken over and it had been given to the C.E.A. in the same way that the power to manufacture plant and fittings had been given to the Gas Council and the Gas Boards. By taking away the power to make fittings the Government were limiting the power to the manufacture of plant for the Board's own use, and there was the further limitation that the power could not be used without the approval of the Minister.

Commercial Freedom Necessary

The nationalised industry could not expect to get men of a high quality into the managerial and top grades unless the Government gave it the maximum possible degree of commercial freedom in its activities, analogous with the freedom enjoyed by private companies. The Government did not believe, however, in the industry wandering into wider fields of activity; it should be limited to the generation and supply of electricity. That was why the Government had taken away the power to make fittings.

The power to manufacture plant seemed to be one of the inherent, essential powers of any commercial undertaking. Constantly, in private industry, companies were making their own plant and setting up their own works, and it would be difficult on principle and on a proper approach to the nationalised industries to take this power away from them. In any event the Minister of Power would ensure that the Board did not enter into manufacturing unless it was in the national interest. At the moment it would be wrong for the Board to enter into manufacture, and he did not think the power would be sought in current circumstances. The Bill would not open the back door for the nationalisation of the heavy electrical industry nor disturb the present excellent performance of that industry.

Mr. Palmer said this power to manufacture was traditional in the supply industry. It should be remembered that the first high-voltage cables were made in a power station at Deptford by Ferranti because he could not get such cables outside. It bore out the fact that this residual power was traditional. The Paymaster General was right in saying that if a statutory body was told " You are not just a public service but must operate as a commercial undertaking " it must be given the normal powers possessed by commercial undertakings. He could not believe that the Board would be in a hurry to use this power and he could not understand why Mr. Nabarro and his friends were making such heavy weather of this. He (Mr. Palmer) served on the British Electrical Power Convention Council and the representatives of the C.E.A. and of private industry got on well together. Private industry knew that the supply industry was unlikely to use this power, so why this fuss and bother ? Everyone realised that time might come when the Labour Party came back into power, and they might wish to nationalise the heavy electrical industry. If they decided to do that, it would not be by the back door but the front. The Opposition recognised that this industry in private hands was a great, efficient and effective industry but that was not to say that its ownership would not be changed.

Vice-Admiral Hughes-Hallett said that if in the future the Board encountered any severe difficulty it should go to the factories owned by the Ministry of Supply, the Admiralty or the Post Office. It would be a great mistake to let the Board set up expensive plant of its own. The real danger was that if the supply industry stopped expanding there would be people running around looking for new empires to build and there would be a proliferation of added functions. A hundred-and-one excuses would be found for going into the manufacturing business in an enormous way.

Mr. Bence said there would be many occasions when the Board might want to use the power to manufacture. Supposing they wanted to manufacture some piece of equipment in an emergency; did the critics intend that there should be a power breakdown rather than let the Board make something on its own premises ?

Viscount Hinchingbrooke asked the Government to withdraw their opposition to the amendment so that the important political principle could be fully debated by the House at the report stage. The Committee had not been told what the Board would want to manufacture, what the C.E.A. had tried to manufacture in the past, and what had been refused to them. The delay in deciding the issue would provide two or three weeks for the subject to be fully debated in the technical Press. If the Government insisted on putting this power back into the Bill they would have to give further evidence that it was necessary because the Paymaster General's speech was altogether too light-hearted a reply to the cogent points raised by Mr. Nabarro. He did not believe it was true that senior executives would go to find new jobs in Canada and South Africa if Parliament refused the Board power to make this heavy range of equipment.

If the amendment went through there would be nothing to stop the Board, with the backing of a Treasury guarantee and special interest rates, making equipment more cheaply than private firms, and if the public complained that this was monopolistic there would be no redress, because the nationalised industries would be outside the scope of the Monopolies Commission.

Government Amendment on Report Stage

When the Committee resumed on Tuesday Mr. Maudling said that in order to meet the objections which had been raised by Conservative members the Government proposed, at the report stage, to put down an amendment to ensure that the Generating Board would not be allowed to exercise the power to manufacture unless the Board was satisfied that the available facilities for obtaining plant at reasonable prices were, or might become, inadequate.

After a debate Mr. Nabarro sought to withdraw his amendment, saying that the controversy could be resumed on the report stage, but leave was not given. The amendment was formally negatived by the Opposition.

The Committee adjourned until yesterday (Thursday).

Safe Bell Transformers

THE new edition of B.S. 1538, which deals with intrinsically-safe transformers primarily intended for bell signalling circuits, extends the scope of the original edition to include requirements for transformers for use in applications additional to coal mining, such as factories and oil-storage depots where there may be a risk of an explosion due to the presence of inflammable gases and vapours. The standard applies only to single-phase, double-wound transformers for supplying circuits which are required to be intrinsically safe as defined in B.S. 1259 " Intrinsically-safe electrical apparatus and circuits."

Comprehensive design data and details of the constructional and test requirements are included in the specification and additional explanatory notes on design and information relating to the measurement of leakage inductance are included in the appendices. Copies of B.S. 1538:1956 may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 4s.

Appleton and the Ionosphere

A SERIES of films on the "History of Modern Science" is being made co-operatively by member countries of the Western European Union to show the achievements of distinguished scientists in the various countries, and a preview was arranged in London last week of the first of these, "Mirror in the Sky." This is presented by Mullard, Ltd., in conjunction with the Educational Foundation for Visual Aid, and has been produced by Realist Film Unit in co-operation with the National Committee for Visual Aids in Education. The film is intended for pupils in grammar schools and technical colleges, both for direct teaching and as a stimulus film, to give boys and girls at a pre-specialist stage a sense of the methods of scientific development. The film runs for 22 minutes and in that brief period covers considerable ground.

After opening with the Marconi experiment of bridging the Atlantic by wireless, it traces the origin of wireless from the early work of Hertz. This is followed by an explanation of the Heaviside layer, and Appleton's experimental confirmation of it in 1924, Sir Edward Appleton himself being seen demonstrating the reconstruction. The discovery of the Appleton layer (the second layer) follows and the development of the pulse technique which formed the basis of radar. Further developments in this field are next dealt with and the film ends with the achievements and potentialities of the radio-telescope in the most recent astronomical research. Although the film is primarily intended for use in schools and colleges, it should prove of more general interest.

Higher Temperature Plastics

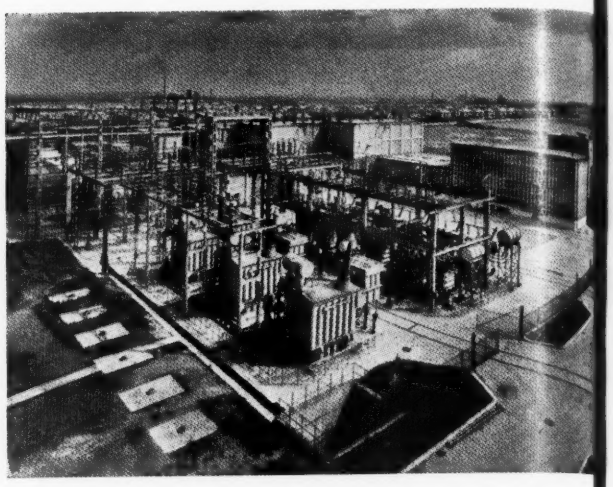
POLYSTYRENE is one of the best low-loss dielectrics known, but its relatively low softening point limits its use to working temperatures below approximately 70-80 deg C. Many attempts have consequently been made to elevate the softening point of polystyrene by chemical modification. These modifications include thermoset, i.e. cross-linked, copolymers of styrene (e.g. with divinylbenzene).

Styrene-divinylbenzene copolymers were prepared by casting, i.e. by pouring a liquid mixture of the monomers into a container and polymerising therein.

The special advantage of cast styrene-divinylbenzene copolymers is that they can combine very much better heat resistance than polystyrene, with electrical properties as good as, or even better than, polystyrene. Though such copolymers have been known for a considerable time and information on their mechanical properties and (to a lesser extent) heat resistance is available, exact data on their electrical properties are scanty. A recent publication of the Electrical Research Association, Ref. IB/T21, "Report on Cast Blocks of Styrene-Divinylbenzene Copolymers," by Dr. V. E. Yarsley (Research Laboratories, Ltd.) (price 6s, from the Association at Thorncroft Manor, Dorking Road, Leatherhead), gives preliminary results on castings which were prepared to supplement this lack of information and to test the ease with which castings of good appearance can be obtained.

N.E.S.C.O.E. Association

THE nineteenth reunion dinner of the N.E.S.C.O.E. Association (North East Coast Electric Supply Companies Old Employees' Association) is to be held on 28th March at the Conservative Club, Pilgrim Street, Newcastle-upon-Tyne. The president of the Association, Lord Gridley, will be in the chair and the principal speaker will be Sir Claude Gibb. On the following day visits will be paid to the works of C. A. Parsons & Co., Ltd., and A. Reyrolle & Co., Ltd., on the invitation of Sir Claude Gibb and Mr. H. H. Mullens. Further particulars can be obtained from the hon. secretary, Mr. S. G. Pike, Room 113, Carliol House, Newcastle-upon-Tyne, 1.



Switchgear Testing

THE revised (1956) edition of Publication No. 1 of the Association of Short-Circuit Testing Authorities (A.S.T.A.) gives an up-to-date account of the Association and its method of operating, and a brief description of some of the plant at its testing stations, which is sufficient to indicate the complicated technique necessary to prove electrical apparatus adequately in accordance with British Standards. It also gives a full account of the facilities available to British manufacturers at these stations, showing how their equipment is tested both for experimental purposes or with a view to obtaining a certificate of rating. One of the stations, at Hebburn, is illustrated above.

The publication describes the operation of the Association as it relates to its important function of proving electrical equipment, and as a certifying authority where the equipment complies with a British Standard or published A.S.T.A. rules. It does not, however, touch on the important part played by the Association in collating the experience on testing obtained through its short-circuit testing plants which ultimately form the basis of A.S.T.A. rules and to some extent provide a guide to those concerned with the drafting of relative British Standards.

The main purpose of the new brochure, which is profusely illustrated, *inter alia*, with photographs of the testing stations owned by member companies of the Association, is to remind the electrical industries at home and abroad of the greatly increased facilities for the short-circuit testing of electrical apparatus in Great Britain operating under the auspices of the Association which are now among the finest in the world.

The following are the companies associated with A.S.T.A. and the addresses of the testing stations.

Owners	Operating Company	Address of Testing Station
British Thomson-Houston Co., Ltd. Metropolitan-Vickers Electrical Co., Ltd. Ferguson, Pailin, Ltd.	Switchgear Testing Co., Ltd.	Mosley Road, Trafford Park, Manchester, 17
Crompton Parkinson, Ltd.	Crompton Parkinson, Ltd.	Chelmsford
George Ellison, Ltd.	George Ellison, Ltd.	Aldridge Road, Perry Barr, Birmingham, 22B
English Electric Co., Ltd.	English Electric Co., Ltd.	Stafford
General Electric Co., Ltd.	General Electric Co., Ltd.	Witton, Birmingham, 6
W. T. Henley's Telegraph Works Co., Ltd.	W. T. Henley's Telegraph Works Co., Ltd.	Gravesend, Kent
A. Reyrolle & Co., Ltd.	A. Reyrolle & Co., Ltd., or British Short-Circuit Testing Station, Ltd.	Hebburn, Co. Durham

PARLIAMENTARY REPORT

Hastings Tramways Bill

A town's protest against a proposal to do away with trolley-buses and to substitute motor-buses was mentioned in the House of Lords last week when the Hastings Tramways Bill received a second reading. Lord Pakenham moved that it should be an instruction to the Committee who would consider the details of the Bill that before authorising the discontinuance of the service of trolley vehicles they should satisfy themselves that the substitution of motor-buses would be to the advantage of the travelling public in Hastings.

He said that the Bill, which would transfer the undertaking of the Hastings Tramways Company to Maidstone & District Motor Services, Ltd., and would authorise the discontinuance of the trolley vehicles, was being petitioned against by the Corporation of Hastings and also, he believed, Bexhill. An all-party committee of citizens had been formed in Hastings, officially representing the political parties in the town. They had passed a resolution stating that the proposals in the Bill were contrary to the overwhelming demand of the local people. They complained that it was designed "to abolish without justification the electric trolley-bus service, which is most suitable for this hilly seaside town," and that it was "contrary to the national interest which demands the minimum use of oil and the maximum use of electric power."

Lord Drogheda, Chairman of Committees, said that as a general rule the House was reluctant to give instructions to a Select Committee and this was one of the cases where the points raised by Lord Pakenham could best be put in the form of petitions against the Bill. As he understood that such petitions were being presented, the matter could safely be left to the Committee.

Lord Pakenham, in view of this assurance, withdrew his motion.

Consultative Council Expenses

Answering a question by Lord Gridley, the Minister of Power (Lord Mills) said that the total cost of the twelve Electricity Consultative Councils in England and Wales for the year ended 31st March, 1956, was £32,169. This sum covered staff salaries, travelling and other incidental expenses; accommodation was provided by the Area Boards, generally without charge. In addition, each chairman of a Consultative Council was paid a salary of £750 in his capacity both as chairman and as an ex-officio part-time member of the Area Board concerned. Other Council members were unpaid. He expressed his appreciation of the work performed by the members of the Councils.

Generating Plant in Scotland

Mr. Niall Macpherson, Under-Secretary of State for Scotland, informed Mr. Nabarro that the capacity of new electrical plant installed in Scotland during 1956 was 255·9 MW. Of this, 101·5 MW was installed at hydro-electric stations at an average cost of £175,000/MW, and 154·4 MW at thermal stations at an average cost of £59,830/MW. A sum of £17·8 million had been spent on generating stations and related capital works which came into full operation during 1956.

Mr. Nabarro asked whether the fact that practically nothing of a new character was authorised by the Secretary of State in 1956 denoted a change in policy on hydro-electric development.

Mr. MacPherson replied in the negative.

Exports to Russia

Mr. Ian Mikardo asked the President of the Board of Trade what was the maximum capacity of turbo-generators the export of which to the U.S.S.R. and Eastern Europe was now permitted.

Mr. Derek Walker-Smith replied that there had been no change since the answer given to Mr. Mikardo in November, 1955. The embargo operated at 60 MW and over. Between 5 and 60 MW, exports might be licensed within quantitative limits. At less than 5 MW exports were free.

National Centre for Nuclear Physics

Mr. Eric Fletcher asked the Chancellor of the Exchequer what steps were being taken for the establishment of a national centre for nuclear physics where the Atomic Energy Authority and the universities could co-operate in research in nuclear physics.

Mr. Powell said the Chancellor hoped to make a statement about this very shortly.

Nuclear Power Programme

In reply to Mr. Peart, the Paymaster-General (Mr. Maudling) said that the Minister of Power hoped to be in a position to make an announcement on the nuclear power programme within a few weeks.

Tanganyika Hydro-Electric Bill

Mr. Lennox-Boyd, Secretary of State for the Colonies, told Mr. John Dugdale that the Pangani River (Hydro-Electric Projects) Bill now pending before the Legislative Assembly was designed to enable the Tanganyika Government to continue to honour obligations which it assumed under an agreement made with the Tanganyika Electricity Supply Co. in July, 1948. Since no increase in the existing guaranteed minimum flow of water in the Pangani River for hydro-electric purposes was involved, other users of water in the area were unaffected.

Submarine Cable Projects

In answer to Mr. Irving, Mr. Thompson (Assistant Postmaster-General) said that new cables to Jersey, to the Irish Republic and to the Continent were planned. He could not yet say when further transoceanic cable projects would be undertaken.

Investment Allowances

Mr. Cronin asked the Chancellor of the Exchequer if he would extend the present category of exceptions to the suspension of investment allowances so as to include the steel, shipbuilding, heavy electrical industries and such other manufacturing industries for which greater capital expenditure was now essential.

Mr. Enoch Powell, Financial Secretary, said the Chancellor had noted this suggestion.

Rate Payments by C.E.A.

In the debate on the Rating and Valuation Bill, which gives rate relief to shopkeepers and tenants of commercial premises by reducing the rateable value of commercial premises by one-fifth, Mr. Bevins, Parliamentary Secretary, Ministry of Housing and Local Government, stated that a second purpose of the Bill was to adjust the amounts payable in lieu of rates by the nationalised industries. With the increase in the average rate poundage and the number of kWh supplied, the C.E.A.'s payments had grown from the standard amount of £11,250,000—which was the estimated amount of rates paid by the industry in 1947-48—to about £16,750,000 in the present financial year, which was a big increase in so short a time. But with the fall in the rate poundage consequent on revaluation from 269d in 1955 to 188d in 1956 the payment of £16,750,000 would fall to about £11,750,000 next year.

In the Bill the standard amount had been fixed to secure that the C.E.A. would pay next year about the same amount as it would have paid had there been no revaluation. It had been shown, unfortunately, that the estimate of the rates paid by the electricity industry in the last year before nationalisation was about £500,000 too much—chiefly because of arguments about assessments which had not at that time been properly determined—and the figure fixed as the standard amount in 1947 was consequently too

high by £500,000. The Government had made an adjustment for this and Clause 2 substituted a revised standard amount of £18,280,000. The consequence was that the C.E.A. would be liable to pay about £19 million in the coming year, which was £2 million more than this year.

Sir Spencer Summers commented in the debate that this action seemed to freeze the burden of rates on electricity undertakings, a position not open to other people, and this discrimination required more justification than the Government had given.

Replying later, Mr. Henry Brooke, Minister of Housing and Local Government, said this was a wrong conclusion. The electricity industry would be paying as much in rates next year as if there had been no revaluation of its properties. It would bear its share of the increase in the total levy of rates and its payment would also reflect any increase in the amount of electricity sold.

Government's Rating Proposals

In a statement on the reorganisation of local government finance last Tuesday Mr. Brooke said that the Government intended, at a date to be fixed, to raise the rate contribution of industry and freight transport from 25 to 50 per cent. At present they were paying only 25 per cent of the net annual value. In addition, changes would be made in the system of "pool" payments to local authorities by nationalised industries, including the direct rating of electricity properties and the separate assessment of electricity and gas showrooms used as shops so that all payments now included in the "pool" would be taken into account as rates. In Scotland the necessity for changes on these lines would not arise in the period up to 1961 for which the existing valuations were "frozen."

The Minister said that the proposed changes would now be the subject of discussions with all concerned. He mentioned other changes in the method of local government finance and said that it was proposed to bring them all into operation at the same time, at a date to be fixed.

Electricity Pensions

Mr. Palmer and other members asked when the comprehensive scheme for improved pensions in the electricity supply industry submitted last autumn to the then Minister of Fuel and Power by the Central Electricity Authority would be approved.

Mr. D. Renton, Parliamentary Secretary, Ministry of Power, said the C.E.A.'s proposals were still under consideration and a decision would be given as soon as possible.

Replying to Dame Irene Ward, Mr. Maudling said that the Minister of Power had informed the Central Electricity Authority and the Gas Council that he was now prepared to approve increases analogous to those under the Pensions (Increase) Act, 1956, for ex-municipal employees with the necessary qualifications who had retired from the two industries.

Mr. Elwyn Jones asked the Paymaster-General how many pensioners were affected by the C.E.A.'s scheme for improved pensions in the industry.

Mr. Maudling said the Authority had not indicated how many would be affected. The estimated cost of implementing the proposals was £164,000 per annum.

Electrical Industries Club

Mr. Christopher Brasher, son of Mr. W. K. Brasher, secretary of the Institution of Electrical Engineers, was the guest speaker at last Tuesday's luncheon of the Electrical Industries Club. He gave an interesting account of his experiences at the Olympic Games in Australia last year and explained the different attitudes which various countries had towards athletics. Mr. Brasher was introduced by the president, Mr. Leslie Gamage, who congratulated him on his Olympic gold medal.

National Golf Championship

At a meeting of the National Committee of the Electrical Industries National Golf Championship held recently, Sir Henry Self, chairman, and Mr. W. J. Bird, deputy chairman, both regretted their inability to continue in these positions. It was unanimously agreed to ask Lord Chandos to occupy the chair in place of Sir Henry and this he has agreed to do. Mr. R. R. B. Brown, chairman of the Southern Electricity Board, was elected deputy chairman.

The following members of the National Committee have retired: Messrs. A. B. Wildsmith, F. W. Leake, W. A. Anderson and W. Lewis Smith. The new members elected are: Messrs. F. Ainscoe (W. H. Smith & Co., Manchester), J. W. Bird (chief engineer, South Wales Electricity Board), T. E. Daniel (chairman, North Western Electricity Board), P. B. Etheridge (Electrical Wholesalers' Federation), D. Q. Holland (Metropolitan-Vickers Electrical Co.), E. A. Mills (late of the London Electricity Board) and C. J. W. Scott (Crompton Parkinson). Both Sir Henry Self and Mr. W. J. Bird have consented to continue to serve on the Committee. Mr. W. D. Taylor is continuing as hon. treasurer and Mr. Frank Farthing as hon. secretary. The national final and annual dinner will take place in Manchester on 30th September.

Business Efficiency Exhibition

Lord Chandos, chairman of Associated Electrical Industries, Ltd., will open the Business Efficiency Exhibition at Olympia on 17th June. The exhibition will close on 27th June.

Brighton Technical College

The annual distribution of prizes, diplomas and certificates took place at Brighton Technical College on 4th February. Dr. G. E. Watts (Principal), in presenting his annual report, said that it was the intention to re-house the College in new buildings, and to hasten its development on the lines of a college of advanced technology. The proposal, which had been submitted to the Ministry of Education, included ample provision for the study of mechanical and electrical engineering up to the highest levels and for research. During the present session the attendance at the College had been 927 full-time and 3,233 part-time day and evening students, of which 202 full-time and 978 part-time students attended courses in the Mechanical and Electrical Engineering Departments. Dr. Watts referred to the inauguration in September last of the sandwich diploma course in electrical engineering. Sir Walter Puckey, who presented the prizes, said that the professional engineer was assuming a much greater importance and responsibility, and that a young engineer must be fully prepared to continue that development.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £245 10s 0d
Fire Refined 99·7%	ton £244 0s 0d
Fire Refined 99·50%	ton £243 0s 0d
COPPER Tubes ..	lb 2s 4⅝d
Sheet	ton —
H.C. wire and strip ..	ton £297 5s 0d
LEAD, English ..	ton £112 15s 0d
Foreign	ton £111 0s 0d
MERCURY	flask £85 15s 0d
TIN, block (English) ..	ton £769 0s 0d
ZINC, G.O.B. Foreign	ton £100 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 0⅛d
Sheet	ton —
Wire	lb 2s 8½d
PHOSPHOR BRONZE Wire	lb 4s 0⅛d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26d—26½d

Edison Anniversary

To mark the 110th anniversary of the birth of Edison (11th February) the electrical industry in the United States sponsored a science-youth day to encourage young people in greater numbers to take advantage of the growing opportunities for careers in science and engineering; to stimulate greater interest in science education; and to focus attention on the critical shortage of scientists and engineers. It is intended that this celebration shall be an annual event.

VIEWS on the NEWS

By REFLECTOR

IN the 1st February issue I commented on the joint meeting of the I.E.E. and its American and Canadian counterparts linked by the new transatlantic telephone cable. I mentioned that telephonic links were often employed by the B.B.C., but I am reminded of earlier examples by Mr. D. H. S. Sanderson, of Roundhay, Leeds. Mr. Sanderson recalls that meetings were held around 1929 simultaneously at the Institution of Electrical Engineers in London and at all the I.E.E. Centres and they were connected by Post Office telephone lines. All the Centre chairmen spoke, as well as the President. Mr. Sanderson also says that about twenty years ago the chairman of the North Midland Centre was prevented by illness from attending the annual dinner (or maybe the opening meeting) of the Centre and by means of a microphone at his bedside addressed the company assembled elsewhere—this, too, being by telephone link.

* * *

Mr. M. G. Locket is reported by the *Manchester Guardian*, at a luncheon of the Coal Industry Society last week, to have accused the coal industry of "suffering from a state of mind brought about by fifteen to twenty years of a seller's market, of price control, allocation, shortage and substitution." He said that all these things tended to an attitude of complacency and resulted almost in stagnation. Mr. Locket drew attention to what he alleged was one result of all this—the fall in domestic coal consumption between 1939 and 1955 by up to 40 per cent. He said that in the same period the consumption of electricity in the home rose by 230 per cent and oil by 35 per cent. But then he went on to say that while coal used to produce electricity had risen by 180 per cent the use of oil for the same purpose had shown a growth of 1,000 per cent. This is an illustration of the distorted ideas that the use of mere percentages may sometimes give. The matter is seen in better proportion if it is known that while the use of oil for generating electricity rose from 20,000 tons in 1938-39 to 222,000 tons in 1955-56 the coal consumption in public power stations increased from 14 million tons to nearly 40 million tons.

Apropos this matter it has been stated that the C.E.A. is reducing its use of oil by 80 per cent to meet the present shortage.

* * *

Surely nobody would claim that the usual street gas-lamp standard was the acme of æsthetic design and yet many elderly people seem to love it—perhaps for its reminder of "better days" long past. It is true that it sometimes seems to suit its surroundings better than the ultra-modern concrete electric lamp standard but that is because lighting authorities are not too careful in their choice of design. Some residents of Richmond (Surrey) are objecting to the supplanting of their old gas lamp-posts by modern fluorescent lamp standards: they do not oppose the change-over to electricity but just the way in which it is proposed to do it. Their stand was supported by "Peterborough" in the *Daily Telegraph* and as one result he has received from Johannesburg a photograph of a gas-lamp standard adapted for electric lighting installed outside a house near that city. It is a genuine "piece," having come from London.

Since writing this I have seen an article in the *Evening News* (Portsmouth) illustrating a number of old gas lanterns, once used in Westminster, which have been installed in Portsmouth. It is said that there are fifteen of them, purchased at a cost of 2s 6d each; they were reconditioned for about £6 each.

* * *

Technical education methods are frequently condemned as producing men with very narrow views and little regard for the problems of the society in which they live. An example of a more liberal curriculum is indicated in an extract published by the *Electrical Contractor and Retailer* from the minutes of an E.C.A. branch meeting. It runs as follows:—

> "*Technical Training.*—On this matter Mr. ——— asked if it was correct that the lads were being taught other subjects than electrical. He was given to understand that sex lectures were now being introduced. As no member of the appropriate committee was present the matter was deferred."

I look forward to the next instalment.

* * *

A couple of weeks ago I reflected upon the tendency of the popular Press to suggest that "atomic" cars and other vehicles were practically here. Consequently, I was not very startled to see a heading "Atom Bus Crash" in the *Daily Mail*. I discovered from the following matter that the bus in question was quite an ordinary bus but as it was carrying workers from the Harwell Atomic Research Establishment it presumably qualified for the title.

* * *

Nowadays electrically-driven saws are often employed for the felling of trees. Another electrical method introduced eighty years ago does not seem to have caught on. As described in the *Electrical Review* of 15th February, 1877:—

> "Mr. H. H. S. Parkinson and Mr. W. H. Martin have patented a process by the application of which a tree that at present takes two hours to fell will come to the ground in fifteen minutes. The plan is simple enough. The copper wires proceeding from the electrodes of a powerful galvanic battery are connected with a piece of platinum, which of course becomes instantly red-hot. In this condition it is see-sawed across the tree which is to be felled. There is no waste of wood, no sawdust, and the idea which certainly seems pretty enough on paper, is said to have been successfully realised."

I should think that the replacement of the "piece of platinum" proved to be an expensive item.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. C. H. Flurscheim, B.A., M.I.E.E., M.Amer.I.E.E., has been appointed chief electrical engineer of the Metropolitan-Vickers Electrical Co., Ltd. Formerly assistant chief electrical engineer, Mr. Flurscheim succeeds **Mr. H. West,** who will thus be enabled to devote more of his time to the affairs of the A.E.I.—John Thompson Nuclear Energy Co., of which he is managing director. Mr. West will retain his seat on the board of Metropolitan-Vickers as director, electrical engineering.

Mr. Flurscheim was educated at Wellington College and Trinity College, Cambridge. He joined M-V as a college apprentice in 1927 and afterwards joined the staff of the Switchgear Engineering Department. During this time he spent a year with the General Electric (U.S.A.) as an

Mr. C. H. Flurscheim

Mr. A. E. Grimsdale

I.G.E. fellowship student. In 1936 he took over the high-voltage division of the Switchgear Engineering Department. During the war period he was responsible for the development of a series of electrical components for aircraft, including electro-mechanical undercarriages, retraction units and miniature circuit-breakers. In 1945 he became assistant chief engineer, and in 1949 chief engineer, Switchgear Department. He was appointed assistant chief electrical engineer of the company in 1953. Mr. Flurscheim has read many papers before the I.E.E. and other technical institutions.

Mr. A. E. Grimsdale, B.Sc.(Eng.), formerly special assistant, sales management, has been appointed manager, home sales, with special responsibility for home district offices of the Metropolitan-Vickers Electrical Co.

Mr. Grimsdale took his degree at Brighton Technical College and joined M-V as a college apprentice in 1922. After spending three years as traction engineer in the company's Sydney (Australia) office, and a further two years in the Traction Control Department at Trafford Park, he transferred to the Traction Sales Department in 1932. From 1941 to 1945 he was assistant to the works manager at the Sheffield works, being concerned with the wartime production of rotating electrical machines for service contracts. At the end of the war he became deputy sales manager, Traction Department, and in 1946 he was appointed manager, Traction Sales Department. He has been special assistant, sales management, since January, 1953; he became a director of the Metropolitan-Vickers Electrical Export Co., Ltd., in June, 1954.

Mr. F. G. Copland, B.Eng., M.I.E.E., has been appointed sub-area engineer of the South Wales Electricity Board's Eastern Sub-Area based on Newport. He takes up his duties on 4th March. Between 1930 and 1950 Mr. Copland held various electrical engineering appointments in Yorkshire, Cumberland, the Isle of Man, Norwich, the Gold Coast, Liverpool and in Cheshire. In 1950 he was appointed development engineer to the North Western Electricity Board with particular responsibility for the design of distribution networks. Mr. Copland succeeds **Mr. W. E. Richardson,** who was recently appointed sub-area manager for the Board's Western Sub-Area.

Mr. C. B. Mullins, LL.B., has been appointed to the post of assistant secretary (administration) of the South Wales Electricity Board. Mr. Mullins was educated at St. Illtyd's College, Cardiff. Before taking up his present appointment he was a principal assistant in the Secretary's Department.

The Central Electricity Authority has appointed **Mr. D. P. Sayers,** B.Sc., M.I.E.E., M.I.Mech.E., M.Amer.I.E.E., chief contracts officer in succession to **Mr. F. W. Smith,** whose retirement at the end of last year was recently announced. Mr. Sayers, who for the past three years has been deputy chairman of the Midlands Electricity Board, previously held the appointment of deputy chief engineer (transmission) of the Authority. In 1936 he became deputy distribution engineer for Sheffield Electricity Supply Department, later being promoted distribution engineer and chief assistant engineer at Sheffield. He was appointed deputy chief engineer and manager of Birmingham Corporation electricity undertaking in 1943 and when the industry was nationalised in 1948 he was appointed chief engineer of the Midlands Electricity Board. A year later he went to the headquarters staff of the C.E.A., where he held successive posts until his return to the Midlands in 1954. While with the C.E.A. he played an important part in the planning of the 275 kV supergrid transmission system now under construction and the cross-Channel cable which will link the supply systems of Britain and France.

Mr. D. P. Sayers

Last year Mr. Sayers was a member of the mission of British electrical engineers who visited the Soviet Union to study its electricity supply system. He is a past vice-chairman of the South Midland Centre of the I.E.E. and has been a member of the Council of the Institution since 1951.

Mr. C. A. Burton, M.Inst.W., who writes in this issue on "Resistance Welding Techniques" (page 273), was educated at the Wandsworth Technical Institute and received his training with Foster Transformers, Ltd. He joined Sciaky Electric Welding Machines, Ltd., as chief test and research engineer when that company opened its Slough Works in 1935. During the last war he was attached to the Directorate of Industrial Electrical Equipment as regional resistance welding adviser. After the war he returned to Sciaky Electric Welding Machines and was appointed technical sales manager in 1948. He is a past president of the North London Branch of the Institute of Welding and is the author of a number of papers on resistance welding techniques.

Mr. C. A. Burton

Mr. A. T. Crawford, assistant contracts manager of A. Reyrolle & Co., Ltd., who is responsible for publicity, has been elected a member of the B.E.A.M.A. Publicity Committee.

Mr. Donald MacPhail has recently been appointed managing director of the Dictaphone Co., Ltd. Mr. MacPhail was previously on the board of the Indestructible Paint Co., Ltd., and before that was with the Dunlop Rubber Co. on sales development and promotion. In 1952 he graduated from the Administrative Staff College,

Henley. Mr. MacPhail is well known in lawn tennis circles, having been a Davis Cup player and a past Scottish singles champion. In the last war he served as a pilot in R.A.F. Bomber Command.

Mr. D. H. Walker, A.M.I.E.E., whose appointment as district commercial engineer of the South West Essex District of the Board we briefly reported last week, was with the Norwich Electricity Department until nationalisation when he went to Great Yarmouth as district commercial engineer to the E.E.B.

Auto Diesels, Ltd., announce a new division within the company to be known as the Pump and Hydraulic Machinery Division. This will embrace the existing pump business in addition to a number of new projects currently under development. **Mr. R. J. Sanders** has been appointed general manager of this division and has been succeeded as home sales manager by **Mr. E. Ward.**

Mr. R. A. Drummond has been appointed sales manager of the recently formed company, Ferranti Radio & Television, Ltd., which, as previously announced, commences operation after 31st March. Now in his twenty-fifth year with E. K. Cole, Ltd., Mr. Drummond has been assistant sales manager, North, since 1954. The head office of Ferranti Radio & Television, Ltd., will be at 41-47, Old Street, London, E.C.1, but all correspondence, etc., should continue to be addressed to Ferranti, Ltd., at Moston, Manchester, 10, until 31st March.

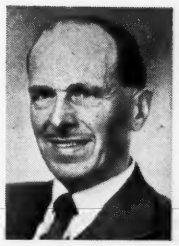
Mr. R. A. Drummond

Mr. R. A. Archer, district commercial engineer of the South West Essex District of the Eastern Electricity Board, has been appointed senior assistant engineer (commercial) at the Essex Sub-Area headquarters. Mr. Archer received his engineering training at East Ham Technical College. He joined the County of London Electric Supply Co., Ltd., after leaving school and for some years was employed at its head office. After appointments in Holborn and Finsbury he went to Essex and upon nationalisation joined the South West Essex District.

Mr. E. S. Little, Companion I.E.E., F.I.A.C., has been reappointed a director of the British Thomson-Houston Co., Ltd., on relinquishing his offices of comptroller and secretary. He will be succeeded as comptroller by **Mr. A. D. Gregory,** M.A., and as secretary by **Mr. A. E. Wilson.**

Mr. Little joined the staff of the company's Accounting Department in 1912. From 1914 to 1919 he served in the R.G.A. and R.E. (Signals), returning to the Department on demobilisation. In 1936, after seven years as accountant-in-charge, Mr. Little was appointed to the position of comptroller, and he retained this office when he became secretary to the company in 1945.

Mr. E. S. Little



Mr. A. D. Gregory

Mr. A. E. Wilson

Mr. Gregory joined the B.T.H. Accounting Department at Rugby in 1929 after experience with a firm of Eastern merchants. During the 1914-18 war he was commissioned in the Royal Scots Fusiliers. Mr. Gregory was made head of the general ledger section in 1940 and head of the contracts section in 1945. Last year he was appointed head of the Accounting Department.

Mr. Wilson, who for many years has been chief assistant to the secretary, joined the B.T.H. Co. in 1925 and after two years in the Accounting Department transferred to the secretary's office, becoming principal assistant to the secretary of the company in 1945.

Mr. F. C. Vine has resigned as the representative of the Accumulator Makers' Association on the Electrical Fair Trading Council, and he has been succeeded by **Mr. F. Topping.**

Mr. H. K. Hadley, whose article on "Power Factor Correction" appears in this issue, received his technical education at the Dudley & Staffordshire and Nuneaton Technical Colleges. He has been with the British Thomson-Houston Co., Ltd., for nearly twenty years. He is now in the Industrial Machines Department, engaged on service matters related to electrical machines.

Mr. H. K. Hadley

The annual staff dinner and dance of **Southern United Telephone Cables, Ltd.,** was held on Friday last at the May Fair Hotel, London, over 300 members of the staff and guests sitting down to dinner under the chairmanship of Sir John Dalton. There were two toasts and responses and each of the speakers spoke in light vein befitting such an occasion. The tone of the evening was set by Dr. E. J. Hooker (works metallurgist), who, in a witty speech, mentioned that this was the twenty-fifth anniversary year of the company. He said 1956 had been a year of record output, and spoke of the staff's appreciation of the pension scheme. He said that the occasion enabled the company to renew old friendships. He welcomed Mr. C. H. Broughton Pipkin, a new member of the board, and expressed the pleasure of all present at seeing Sir John Dalton after his absence abroad.

Mr. J. E. Sunderland (director), in responding, said he was speaking for all sections of the company. In referring to the record output in the past year, he said that the team spirit was the main reason for the company's success. He congratulated Dr. Hooker on having recently obtained the degree of Ph.D., and spoke in high terms of the work of Mr. A. F. Lampitt, director and general manager.

Sir John in a jovial speech of welcome to the guests mentioned that representatives of a number of Government Departments were present, and he especially welcomed the ladies. Mr. H. A. S. Warner replied for the guests.

The dancing which followed the dinner was interspersed with some excellent cabaret items.

Mr. A. G. Colston, technical adviser (service), of Hoover, Ltd., and a director of Hoover (Electric Motors), Ltd., is to retire from the company at the end of March after more than thirty-three years' service. Mr. Colston studied electrical engineering at Finsbury Technical College and was then apprenticed to Siemens Brothers & Co., Ltd., Stafford, for two years, before joining the Royal Engineers in the 1914-18 war. He joined Hoover, Ltd., in 1923, and became service manager in 1930, being designated technical adviser (service) in 1956.

Mr. P. C. Jones, sales director of Allen West & Co., Ltd., has retired from the board.

Mr. C. A. Henderson, Metropolitan-Vickers manager in the Levant, recently returned to this country with his wife and family. Shortly before doing so, he was decorated by the President of the Lebanon with the Order of the Cedars, Officer's degree.

The annual dinner and dance of the Western Centre of the **Institution of Electrical Engineers** will be held on 29th March at the Grand Spa Hotel, Bristol. Sir Gordon Radley, President, will be present. Tickets are 25s each, while students and graduates may

attend the dance only at 7s 6d each. Applications should be made to Mr. W. D. Morgan, hon. assistant secretary, W. T. Glover & Co., Ltd., 123, Victoria Street, Bristol.

Councillor R. Wood, one of the founders, and first president, of the Society of Automotive Electrical Engineers, has accepted the invitation of Huddersfield Town Council to be the next Mayor of Huddersfield. Councillor Wood is managing director of Wood Auto Supplies, Ltd.

In the past nine months £44,000 had been disbursed by the **Electrical Industries Benevolent Association,** Mr. R. H. Ellis (chairman) stated at the recent annual dinner of the Nottingham Branch. Mr. Ellis said grants made in the previous year totalled £45,000. He thought the industry should give more support because out of the 250,000 non-manual workers who could claim benefit only some 12,000 were subscribers. The chairman later presented a cheque for £65, the proceeds of a ball last October, to Mr. H. S. Fothergill, the general secretary. Mr. H. Riley, E.I.B.A. president, said that in ten years to 1955 grants had risen from £12,750 to £47,000, and the number of recipients from just over 4,000 to 19,000.

At the annual dinner of the Nottingham Branch of the E.I.B.A. Left to right : Mr. S. N. Hind (secretary), Mr. H. S. Fothergill (general secretary), Mr. R. H. Ellis (chairman), Mr. H. Riley (president) and Mr. C. R. King (chairman, East Midlands Electricity Board)

Mr. G. V. Strudwick, C.B.E., director of contracts, Ministry of Works, has retired and has been succeeded by **Mr. A. R. Plowman,** at present deputy director of contracts.

Mr. J. E. Furley has been appointed publicity manager to E. K. Cole, Ltd. In addition to controlling the advertising of Ekco radio and television receivers, he will also be responsible for the publicity of other Ekco products, including Thermovent heating equipment, plastics, electronic and nucleonic equipment. Mr. Furley, who has been assistant publicity manager since 1952, joined E. K. Cole, Ltd., in 1932.

Mr. J. E. Furley

Mr. D. W. Aldridge, M.C., M.I.E.E., has been appointed chairman of the Telegraph Condenser Co., Ltd.

The North Western Branch of the **Electrical Trades' Commercial Travellers' Association** is holding its ladies' evening on 21st February at Alma Lodge Hotel, Hazel Grove, Stockport. Applications for tickets should be made to Mr. K. Snelson, social secretary, 15, Ridge Crescent, Whitefield, nr. Manchester.

The annual dinner and dance of the Staff Association of the **Telegraph Construction & Maintenance Co., Ltd.,** and its associate company, **Submarine Cables, Ltd.,** was held at the Dorchester Hotel, London, on 8th February and was attended by nearly 500 members and their guests. In proposing the toast to the company, Mr. H. F. Wilson, assistant managing director, Cables Group, and manager of Telcon Works, Greenwich, referred to the successful completion of the manufacture of the greater part of the first transatlantic telephone cable by Submarine Cables, Ltd., at the Ocean Works, Erith, and the bestowal of a knighthood on Sir John Dean, chairman of the company. Replying, Sir John said that he regarded the honour conferred on him as given to the company and not to himself only. Referring to the Staff Association, he said that since it was formed in 1948 the staff had increased from 350 to 900 members. Mr. W. F. Randall, managing director of the Metals Group, in proposing the "Staff Association" said that its ramifications were now very wide, embracing factories in England and Scotland and in several countries abroad. The toast was acknowledged by Mr. W. R. Martin, personnel manager and chairman of the Association.

On 25th January **Morphy-Richards, Ltd.,** gave a dinner at the Cumberland Hotel, London, to representatives of companies which supply them with materials and parts for their range of appliances. Mr. D. W. Morphy (joint managing director) presided over a gathering of 120 people.

The staff party of **Hurseal, Ltd.,** was held on 1st February at the Hungaria, London. Among those who attended were Mr. F. S. Bassett (chairman), Mr. A. C. Hazel (managing director) and Mr. B. L. B. Hutchins (director).

The South of Scotland Electricity Board has appointed **Mr. W. A. Walker,** A.M.I.E.E., as commercial officer, Dumfries and Galloway Area, with effect from 1st March. Mr. Walker is at present district commercial engineer in the Kilmarnock district of the Board's Ayrshire Area.

OBITUARY

Air Vice-Marshal O. G. W. G. Lywood, C.B., C.B.E., L.M., whose death occurred on 3rd February, had, in addition to his Service career, made outstanding contributions to the British telecommunications industry. He became a director of the Automatic Telephone & Electric Co., Ltd., on his retirement from the R.A.F. in 1946. His senior appointments during the last war included those of Director of Signals at the Air Ministry and, from 1942 until his retirement, Air Officer Commanding No. 26 Group, R.A.F. Until ill-health forced him to resign from the A.T.E. board in 1955, his main activities for the company were in the radio and transmission fields. After his resignation he remained a consultant and continued as chairman of A.T.E. (Bridgnorth), Ltd., until the time of his death.

Mr. A. G. N. Dixey.—The death occurred on 25th January at the age of sixty-three of Mr. A. G. N. Dixey, who until his retirement last year was secretary of the Edison Swan Electric Co., Ltd. Mr. Dixey joined the Metropolitan-Vickers Electrical Co., Ltd., in 1920 as a college apprentice and was transferred to Associated Electrical Industries at the date of its formation. During his service with the group he was at various times assistant secretary of A.E.I., secretary of Sunvic Controls, Ltd., Met-Vick. G.R.S., Ltd., and the Switchgear Testing Co., Ltd. He was appointed secretary of the Edison Swan Electric Co. in 1946.

Mr. Wyatt Meacher, M.I.E.E., died on 2nd February, after a short illness, at the age of eighty-four. He was a founder of the Westminster Engineering Co., Ltd., in 1896 and in 1902 built the first factory at North Acton.

He became managing director and right up to the time of his death he continued to be an active executive in the company. In his early days he was a student at Faraday House, and for a period was with Ferranti, Ltd.

WILLS

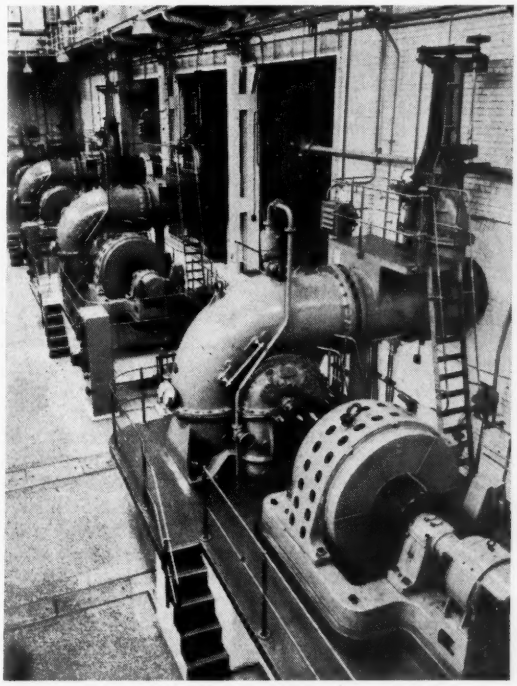
Mr. E. J. Riordan, B.E., M.I.E.E., chief engineer of Aron Electricity Meter, Ltd., who died on 14th November last, left £16,095 gross (£15,016 net).

Mr. B. C. Wren, traffic manager for Pirelli-General Cable Works, Ltd., who died on 30th September last, left £3,691 gross (£2,916 net).

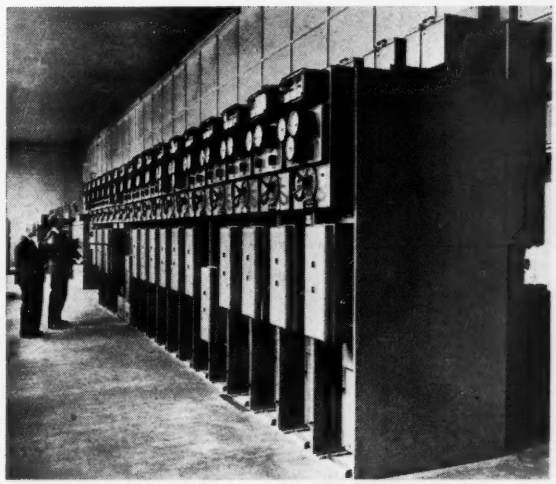
Mr. E. V. C. Habgood, purchasing officer in the Essex Sub-Area of the Eastern Electricity Board, who died on 25th July last, left £5,390 gross (£5,344 net).

MANUFACTURING PROGRESS IN 1956

Crompton Parkinson, Ltd.



Pumps at the Southern Outfall Sewage Works, Erith, driven by 525 h.p. auto-synchronous motors



Crompton Parkinson 18-panel, 3·3 kV 150 MVA switchboard for Leyland Motors, Ltd.

As well as continuing to maintain its factories as efficient production units during 1956, Crompton Parkinson, Ltd., made considerable progress with factory extension and reorganisation projects. At Chelmsford, an extension to the central development and research establishment was completed (see page 298) and progress made with the erection of additional switchgear shops. At the Hayes transformer works an extensive re-building and reorganisation scheme was completed, and at Southall, where transformer tanks are produced, an extension was completed which has enabled the factory's output to be doubled.

Developments at the Newport battery works included the commissioning of a new lead oxide plant, and a plant concerned with the new " factory sealed charge " battery process. The cable works at Derby were extensively re-equipped, and at Doncaster an electrostatic spraying plant for lighting fittings, the first of its kind in Europe, was commissioned. There was also extensive factory development in Canada, Australia and India.

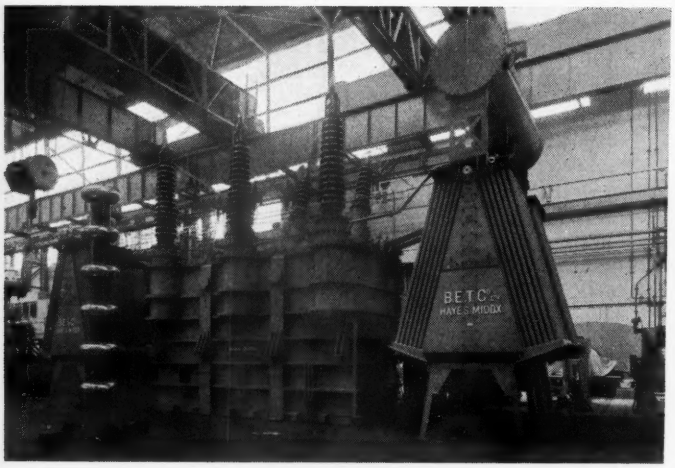
There were several product developments during the year. The most recent of these was a new range of standard ventilated squirrel-cage a.c. motors employing " Class E " insulation and with ratings from 1 h.p. up to 50 h.p. Another development resulted in the introduction of a 2 to 25 h.p. range of d.c. motors of a totally-enclosed fan-cooled design. The company's self-regulating alternators in the range 6 kVA to 135 kVA were also mechanically re-designed. With f.h.p. motors the general-purpose three-phase range, based on the B.56 frame to B.S. 2048, was widened by the introduction of totally-enclosed fan-cooled machines. In collaboration with Airmec, Ltd., variable speed control equipment was developed for use with d.c. machines up to 1 h.p.

With regard to batteries the most important development was the installation of the new " factory sealed charge " process plant for car batteries. This means that the formation charge, which is built into all batteries during manufacture, is not lost during the plate drying process but is retained until the batteries are required for service. As well as the standard " Golden Crompton " batteries with the last-mentioned feature, a range of long-life car batteries was also introduced.

Instrument progress included the development of new ranges of rotary synchroscopes and 360 deg scale power-factor indicators, and also a precise speed indicator comprising a miniature three-phase alternator and a rectifier type moving coil voltmeter. Several developments were also made in the lighting equipment field.

With regard to business, the company had a successful year. For the National Coal Board's Avenue Carbonisation Plant at Wingerworth, Chesterfield, a total of 81 switchgear units was supplied. For the Manvers Main Colliery and carbonisation plant, both transformers and switchgear were involved on a large scale, the transformers varying in size from 110 kVA to 1,500 kVA. At the N.C.B. Central Engineering Establishment at Bretby, the company were contractors for the whole of the substation equipment and the ring-main cable installations.

Typical of other specialised fields in which the company was engaged are those of water supply and sewerage. For the Hanningfield reservoir scheme, which is believed to be the largest post-war conservation project of its type, a six-panel main h.v. switchboard, l.v. switchgear, transformers and power cabling were supplied. For the £10 million Southern Outfall development scheme of the L.C.C., all the distribution plant and the four auto-



One of four 120 MVA 275/132 kV auto-transformers for the C.E.A.

synchronous motors, which replaced the pump steam engine drives, were supplied and installed by the company. Among many other contracts was a scheme for a bath manufacturing company involving electrical installations to cater for a large automatic sand handling plant; comprehensive power supply and motorisation schemes for two paper mills; the supply of motors to a large machine tool manufacturer for transfer machines employed in car manufacture; and several large industrial electrification contracts for car body and radio industry plants.

The company continued to make very good progress in export markets, despite keen international competition. Rotating plant orders included several of substantial value covering auto-synchronous motors for installation in Australia, India and South Africa, and alternators for schemes in Argentina, Iraq and Jamaica. A large number of d.c. marine motors were exported to Holland for ship installations, whilst notable exports of a.c. motors included nearly 700 machines for the British Aluminium Company and nearly 300 more machines for the Kitimat Works of the Aluminum Company of Canada. Exports of f.h.p. motors were extensive, a substantial part of the Doncaster works production now being sold directly overseas.

Among the large orders for switchgear was one for a 17-panel, 11 kV duplicate-busbar, truck cubicle switchboard with a remote control board and another covering similar equipment, but of single-busbar design, for installation in India. Orders for distribution transformers were received from Trinidad, Canada and South Africa. Export business was also particularly good in respect of cable, and orders were received from Canada, India, Malta, New Zealand, Portugal and Rhodesia.

There was a steady expansion of business for stud welding plant and welding attachments in a widening range of industrial applications at home, and similar progress was also made overseas where the company now has licensees and concessionaires established on a world-wide basis. In the field of electric traction, work proceeded on diesel-electric orders which represent a substantial share of the business placed by British Railways under their Modernisation Plan.

Finally, reference must be made to the company's new interest in atomic power stations. A group known as Atomic Power Constructions, Ltd., has been organised for the design and supply of atomic power stations in the United Kingdom and abroad. With Crompton Parkinson, Ltd., in the new group are Richardsons Westgarth & Co., Ltd., and International Combustion (Holdings), Ltd. The building, civil engineering and structural work for the group will be undertaken by Trollope & Colls, Ltd., in association with Holland & Hannen and Cubitts, Ltd.

Power Engineers' Salaries

Negotiations Broken Off

THE Electrical Power Engineers' Association, which claims to represent 85 per cent of the total electrical staff employed in electricity generation and supply, has published a protest in pamphlet form ("Penny Wise—Power Foolish") against the delay in the consideration of its claim for better salaries for its members and the "trivial improvements" which have been offered.

This stated that the niggardly salary policy of the Central Electricity Authority and Electricity Boards will result in a lowering of the standard of technical engineering in the industry with very adverse results. The losses sustained by holding down the salaries below the level necessary to compete on reasonable terms with other employers will be "a thousand times greater" than the small savings achieved.

Attention is drawn to the great improvements in electricity supply since 1948 when the industry was nationalised. The lion's share of the credit for this, it is claimed, may be attributed to the technical staff which has not risen in numbers to anything like the same extent as the amount of generating plant and number of consumers.

This has brought about a great saving and the price of electricity is only one-third higher than before the war. An artificially low restriction of price, however, should not result in low salary standards.

It is pointed out that the Herbert Committee referred in its report to the need for attracting and retaining an adequate supply of first-rate talent for technical and managerial posts by the payment of adequate salaries. The Association suggests that this need is increased by the advent of nuclear power stations.

The Association claims a restoration of the percentage differentials which existed between the various levels of salaries in 1948 and the up-grading of some designations whose responsibilities have been increased by the technical developments mentioned in the pamphlet. It says that "having failed, despite months of patient discussion, to reach with the Central Electricity Authority and the Area Electricity Boards even a basis from which we can see a prospect of agreement, we have withdrawn from the discussions. As the Association of technical staff employed in the generation, transmission and distribution of electricity we must now contemplate what other steps are open to us to ensure serious and reasonable consideration of our just claims. We are anxious therefore that the facts of the situation should be widely known, so that the public will understand any future action to which we may reluctantly be driven."

Electrical Machines. By A. Draper. We regret that in our review of this book last week the publishers were incorrectly given as George Newnes. The book is published by Longmans, Green & Co., Ltd., 6 and 7, Clifford Street, London, W.1, price 40s.

The Telephone Problem

The following is an account of the progress which is being made by the Post Office in reducing the arrears of telephone installations and some of the problems involved

Thanet Telephone Exchange

LAST year the Postmaster General spoke at Cardiff at a ceremony to mark the installation of the seven millionth telephone in the United Kingdom. The emphasis in his speech was on the expansion and improvement of Post Office services—from the introduction of subscriber trunk dialling to the provision of new facilities such as the Test Match score service. He pointed out that just before the war there were some 3¼ million telephones and about 240,000 new connections were made each year. By comparison, in 1955 over 430,000 new connections were put in and during the past five years nearly two million new lines have been connected. To people waiting for a telephone this may seem incredible, or at best ironic, but the fact is that the Post Office is pushing forward with its plans for extending and improving the telephone service. There still remain some 300,000 applications on the order list, although the figure is falling rapidly.

To understand something of the problem of providing telephones, it is important to realise that economic and efficient telephone service requires detailed and long-term planning. As each subscriber, or pair of sharing subscribers, requires a separate line to, and apparatus at, the exchange, the future demand for telephones must be estimated not in bulk, but in detail.

Effects of Social and Economic Changes

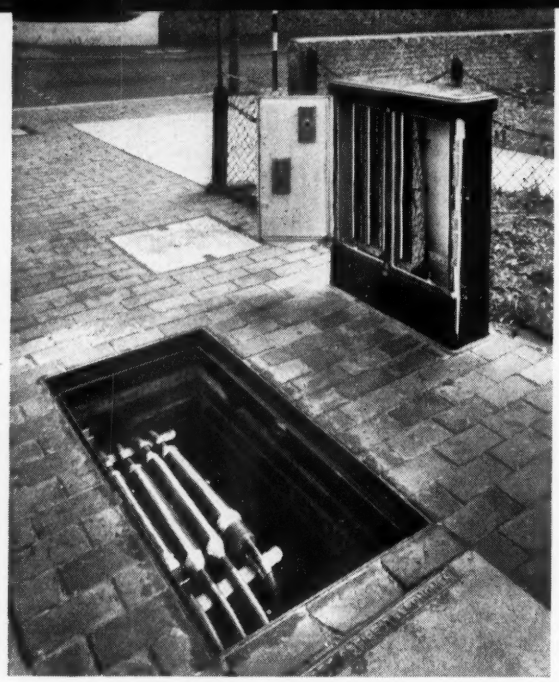
Expedients are continually being adopted to meet short-term needs. The provision of telephone service on a large scale, however, is essentially one of long-term planning. Finding a suitable site centrally situated (which is especially difficult in an expanding town where many new telephones are needed), building and equipping an exchange and bringing it into use may take five years or more, if the exchange is a big one. To plan and lay a cable may take more than eighteen months, especially if new ducts are required and streets have to be opened up for their installation.

However well the plans are made, they cannot be carried out unless the resources are available—capital, materials, and labour to do the work, much of it highly skilled. During the war the system of exchanges and cables could not be expanded regularly and consistently to cater for civilian needs. What is perhaps less obvious, the social and economic changes occurring during the war and the immediate post-war years altered the pattern of demand for telephones. New industries, increased output and full employment made more and more people want telephones. Demands rose from about 240,000 a year before the war to about 300,000 in 1946, and to over 500,000 in 1955. Many of these telephones were wanted in areas where it was expected that comparatively few would be needed. The national economic situation meant that capital expenditure, materials and labour for use at home had to be strictly limited, and the need to build houses further depleted the national resources available for such buildings as telephone exchanges.

Shared Lines

In spite of these difficulties, the Post Office was doing better than before in terms of the supply of telephones, but the number of unsatisfied orders rose rapidly. Faced with this double challenge of restricted supply and increasing demands, the Post Office had to cut its coat according to its cloth. To make sure that available resources were used as fairly as possible, the system of priorities first made necessary by the war was revised for application to post-war conditions, and in 1949 all new and removing residential subscribers were asked to accept the liability to share their lines if necessary. These measures were not attempts by the Post Office to escape its obligation to provide an adequate telephone service; they were designed to make the best possible use of the resources to hand. By the nature of the telephone system, the number of telephones available varies from place to place; one area may have its exchange and cable system nearly full, another may have room for many new subscribers. Nevertheless, the priority system tried to allocate them sensibly. Roughly speaking, doctors, hospitals, fire and other essential services had the highest priority, farmers and businesses came next, and ordinary residential subscribers last, with old subscribers coming before new applicants, and people who had been waiting a long time before those who had only just applied. In districts where plant is still scarce, these priorities are still applied.

This system has caused few complaints, but perhaps inevitably some people have objected to having to share their lines. Sharing is a feature of many telephone systems—in America, for instance, over 60 per cent of all residential subscribers share, many of them on four-



Cabinet cross connection

party lines. In Britain only about one in three residence subscribers share and then only with one partner. Very rarely does the Post Office get a complaint of inconvenience from a subscriber who is sharing. It is the declared aim of the Post Office that as soon as possible anyone who wants an exclusive line should be able to have one.

The Treasury has been able in recent years to allow increasingly large capital investment for the expansion of the telephone system, as shown in the accompanying table. With these increased funds and the gradual improvement in the supply of the necessary materials, big inroads are being made into the order list. More and more new cables are being laid, flexibility points are being introduced into the cable distribution network and new exchanges are being built. The annual expenditure on new telephone buildings has just about doubled in the last four or five years and 200 new buildings were started last year.

Financial year ended 31st March	Telephone Investment
	£ million
1952	50·0
1953	60·0
1954	66·4
1955	70·1
1956	84·0

So far so good, but what of the future? The rate of future building and cable-laying depends to some extent on the general economic situation, but the rearrangement of plans made necessary by the cut of £5 million in Post Office expenditure in 1956-57 will not affect the immediate position; in general, the money will be saved by stretching out the longer-term projects. In the next three years it is hoped to put in 1½ million new telephones.

FRANCE'S ELECTRICAL TRADE

THE bulk of France's electrical exports, valued at £51·2 million last year, was, as in previous years, directed to her overseas possessions. The following tables show that exports to foreign countries were mainly to the Benelux countries, West Germany, Turkey, Spain, and Latin America. Group 1 includes motors, generators, transformers, convertors, switch- and protective gear, control apparatus, wires and cables, relays, accumulators and batteries. Group 2 includes signalling apparatus, telecommunication and TV equipment, electro-medical and heating appliances, lighting fittings, etc.

Table 1.—French Electrical Imports (£000)

Country	1954	1955
United Kingdom	2,567	2,364
Austria	110	164
Belgium	902	826
Denmark	88	139
Holland	1,887	2,227
Italy	1,653	1,035
Sweden	291	437
Switzerland	1,638	1,927
United States	5,232	5,879
Total incl. other countries	19,420	21,816

Table 2.—French Electrical Exports (£000)

Product	1954		1955	
	Foreign Countries	French Overseas Possessions	Foreign Countries	French Overseas Possessions
Generators and motors	2,080	1,708	3,106	1,710
Locomotive motors	380	124	377	37
Parts of motors	808	879	342	466
Transformers (instrument, medical and welding)	280	251	384	201
Switchgear	1,962	1,209	2,198	1,479
Control and protective apparatus	1,907	1,633	2,775	1,870
Signalling apparatus	178	112	295	131
Lighting equipment	465	1,484	645	1,497
Telephone and telegraph equipment	1,367	1,942	1,276	2,189
Radio equipment	2,727	2,988	4,589	3,020
Radio valves	655	247	1,032	287
Electro-medical equipment	293	377	301	426
Electro-thermal and household equipment	865	2,244	1,276	1,955
Vehicle equipment	1,074	1,366	1,191	1,347
Accumulators	886	2,544	650	2,290
Insulation materials	584	223	556	313
Cables and wires	5,100	2,853	2,726	3,105

Table 3.—French Electrical Exports (£000) (by product groups)

Country	1954		1955	
	Group 1	Group 2	Group 1	Group 2
United Kingdom	286	345	185	448
Belgium—Luxemburg	3,739	1,514	1,272	1,534
Denmark	16	53	26	90
Finland	56	95	55	155
Greece	253	34	241	46
Holland	1,353	575	1,466	1,055
Italy	259	497	412	1,131
Norway	101	58	69	42
Poland	108	33	140	88
Portugal	179	88	380	194
Spain	1,829	348	2,997	530
Sweden	57	232	88	383
Switzerland	314	1,215	360	485
Turkey	547	384	1,000	310
West Germany	614	213	735	235
Russia	945	—	341	—
Yugoslavia	394	115	376	78
Iraq	12	—	124	16
Lebanon	243	42	283	112
Syria	256	21	120	31
Egypt	520	264	908	1,028
India	13	106	40	100
Pakistan	76	23	56	19
Indonesia	215	14	103	30
Argentina	710	146	428	1,218
Brazil	382	205	1,042	515
Chile	25	28	40	74
Colombia	615	65	296	27
United States	369	498	225	404
Peru	333	13	184	30
Uruguay	258	77	361	39
Venezuela	209	65	374	53
French East & West Africa	1,993	1,310	1,872	1,810
Algeria	3,474	3,534	4,458	4,640
French Cameroons	416	303	431	281
Guadelupe	88	75	119	106
Madagascar	451	365	663	416
Morocco	3,055	2,484	2,126	2,113
Martinique	82	94	116	153
Tunisia	992	1,020	1,463	935
Cambodia, Laos and Vietnam	1,651	1,552	971	680

D.C. COLLIERY WINDING

Application of Ward-Leonard System to Control Exciters

AS part of the extensive programme for modernising the coal industry in this country, the National Coal Board placed contracts with the General Electric Co., Ltd., for the supply and erection of two geared Ward-Leonard d.c. winders for Silverwood and Cadeby Collieries in the North Eastern Division. In this article the winder at the East Shaft of the Silverwood Colliery is described and illustrated, but the information applies equally to the equipment in service at No. 2 shaft of the Cadeby Colliery.

The winder is designed to raise 525 tons of coal per hour from a depth of 2,299ft and is driven through single-reduction double-helical gearing by a d.c. motor rated at 3,700 h.p., and running at from zero to 320 r.p.m. The 0 to 650 V d.c. supply is provided by a 2,650 kW Ward-Leonard set, of which the 11 kV synchronous driving motor is started by the reactor method.

There are two parallel drums, each 18ft in diameter, one of which is clutched and the other fixed on the drum shaft. An interesting feature is the method of rope grooving employed, whereby the rope is laid across the drum during coiling on the first layer. This grooving is designed to eliminate the undesirable effect of "rope flap," as experienced with the normal series of parallel grooves which have hitherto been employed for multi-layer coiling.

The mechanical brakes operate on a variable-pressure principle. This brake system consists, essentially, of two brake engines, one being a double-acting pressure engine which, for normal operation, applies both sets of brakes, and the other a standard weight type brake engine, which, in the event of changing winding levels, applies the loose drum brake so that the clutch can be withdrawn. The clutch engine and weight brake engine are interlocked so that it is impossible to withdraw the clutch until the loose drum brakes are fully applied, or to release the brakes until the clutch is engaged.

The rate of application of the brakes during the high-speed period of the wind is controlled by a slow braking valve which is operated by cam gear and restricts the flow of oil from the brake engine. Rapid application of the brakes is possible during the acceleration or retardation periods.

Speed control of the winder is effected by the control exciter system which combines the most desirable features of the "three-field" generator with those of the straight Ward-Leonard arrangement. It is simple to operate and maintain and is extremely sensitive, giving, perhaps, the highest accuracy of speed control commercially attainable.

The control exciter system differs fundamentally from earlier methods of control in that a definite transition is made from an open-loop to a closed-loop system in which a controlling input signal proportional to the required speed is compared with a signal proportional to the quantity actually obtained from the system output. Any discrepancy in these two quantities corrects continuously the output quantity to the desired degree of accuracy.

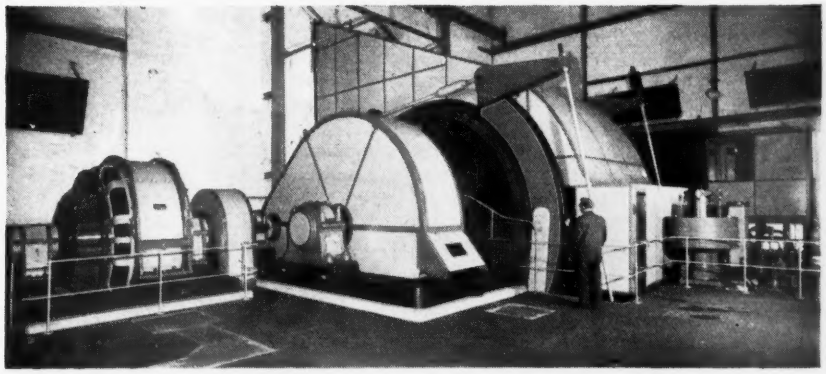
In view of the size of the winder motor and the degree of amplification required, two control exciters are installed and are connected in cascade.

The complete system is shown in schematic form in the diagram on page 296. The pilot exciter PE feeds the field system of the main control exciter ME, which in turn excites the main generator G. A constant voltage exciter CVE supplies the field WMF of the winder motor WM, the brake solenoid, and the operating coils of the various contactors and relays. With the winder motor at standstill and the driver's lever in the "off" position, the pattern potentiometer PP is de-energised, and the customary "suicide" connection through contactors SC is made for the generator field. Movement of the driver's lever first actuates the appropriate contactors to connect the main generator field across the armature of the control exciter ME, and the potentiometer PP to the constant voltage line in the appropriate sense for the required direction of rotation. The selected voltage, as determined by the position of the driver's lever, is now applied to the pattern shunt field A1 and A2 of the pilot exciter PE and main exciter ME, respectively.

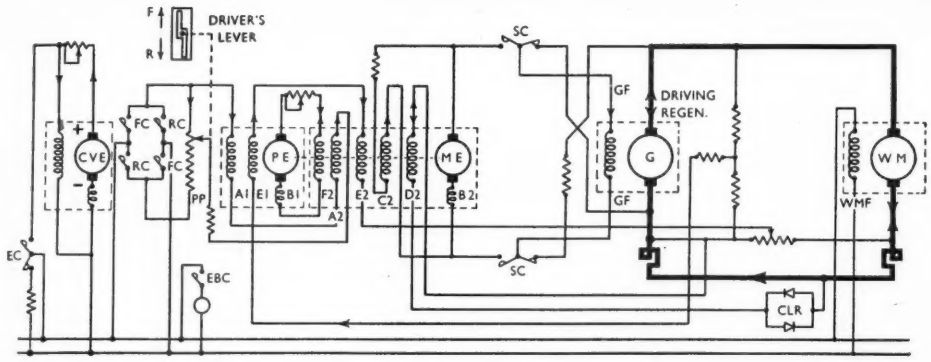
The pilot exciter immediately energises the field F2 of the main exciter. At this stage the three fields, A1, A2 and F2, are unopposed, so that a forcing voltage is built up across the main generator field GF and a voltage appears at the generator terminals. It should be noted that excitation of the exciter PE and ME is further assisted by the series fields B1 and B2.

So long as the mechanical brake of the winder is applied, the current flowing in the generator/motor loop circuit will be limited to a predetermined value (usually about twice full load) by the current-limiting field D2, which is supplied through the rectifier CLR, as previously explained.

On releasing the brake, the motor WM will begin to accelerate and generate a back e.m.f., but the combined effect of the control exciter fields A2, F2 and D2 is such that the excitation of the generator G, and consequently



3,700 h.p. geared d.c. winder at the East Shaft of Silverwood Colliery



Diagrammatic arrangement of the control exciter system for the 3,700 h.p. winder

its voltage, is automatically increased at the necessary rate to maintain the required current in the generator/motor loop circuit.

As the speed of the motor rises and the generator voltage increases, the reset fields E1 and E2 of the control exciter set are energised. The voltage applied to these fields is made proportional to the back e.m.f. of the motor by means of a resistance network, so that it reflects very closely the speed of the motor. The fields A1 and A2 are now opposed by E1 and E2, and acceleration at constant torque continues until the motor reaches the desired speed. At this speed, the fields A1 and A2 are very nearly balanced by E1 and E2, a very small difference sufficing to maintain the requisite excitation and voltage of the generator G.

It should be appreciated that throughout the acceleration period, the current-limiting field D2 opposes the resultant field produced by the windings A2, E2 and F2 so that the current flowing through the motor is limited to the desired value.

Furthermore, the fields A2, E2 and F2 are so proportioned in relation to the characteristics of the pilot exciter PE that the main exciter ME gives maximum output whenever the speed of the motor WM differs from the required speed by more than 10 per cent. This slight "looseness" facilitates manœuvring at low speeds by allowing a measure of torque control.

A similar sequence of events takes place when the winder is running at a steady speed and the driver's lever is returned to stop. Thus at all times the winder speed is made to follow the position of the driver's lever very accurately, being subject only to temporary divergence due to the current limit feature.

It is deserving of note that since the winder was commissioned its performance has fully substantiated the claims made for this system of control which, it will be appreciated, is readily adaptable to automatic winders and is particularly suitable for friction winders where the avoidance of ropeslip is of paramount importance.

Acknowledgment is made to the National Coal Board for permission to publish this information and for the facilities granted to obtain photographs of the installation.

Current Trade Problems

MR. F. ROSTRON'S REVIEW

ON Monday last Mr. F. Rostron, M.B.E., M.I.E.E. (export sales manager, Ferranti, Ltd.), delivered his address as president of the Manchester Chamber of Commerce. In the course of this Mr. Rostron said that industrial production in Great Britain was not good enough. If we were to check inflation and counter the severe competition met with in overseas markets the output per man had to increase. We could no longer increase wages without a corresponding rise in production.

After surveying conditions in the cotton and rayon industry Mr. Rostron turned to the subject of price levels. He deprecated the Government's attacks on co-operation between manufacturers, and said that manufacturers had been forced into the maintenance of level prices for level performance by the "clever" purchaser with his "Dutch auction" methods. If a manufacturer cut his profit margins by ignoring properly chargeable costs he would quickly be forced down the slippery slope of no-profit prices to stagnation in technical development and the cutting of designs of equipment to the bone. Ultimately workers' conditions and amenities would have to be sacrificed.

Under these conditions the less heavily financed companies would be forced out of business and there would inevitably emerge one or two large manufacturing units, bringing the industry very much nearer to monopolistic conditions than could possibly emerge from reasonable price consultation between a larger number of producing units.

As regards level prices in tendering, Mr. Rostron said that the price advantage of any small superiority in design was completely swamped by the common prices for commodities and services which manufacturers had to pay. Level prices had the advantage that the engineer-buyer, unhampered by "buy-on-price-and-nothing-else" considerations forced upon him by administrators, could choose the plant which experience had taught him to be the best for various reasons.

Mr. Rostron cited the Kariba (Southern Rhodesia) hydro-electric contracts and other instances to show how British manufacturers could succeed by this policy. He quoted the *Electrical Review* of fifty years ago to show that uncontrolled price-cutting had disastrous effects on the electrical industry of that time.

The president next studied the prospects of nuclear power and proceeded to deal with the applications of electricity in the cotton textile industry. He then made a brief survey of the proposals for European trade co-operation. He expressed his fears of the results for this country and considered that it would be more profitable to us to strengthen the economic interdependence of the Commonwealth countries and re-double our efforts in the U.S.A.

Report on Calder Hall

CALDER HALL "A" nuclear generating station is now complete and fully in commission with an installed capacity of 92 MW. This was announced at a Press conference in London last week by Sir Christopher Hinton, F.R.S., managing director of the Industrial Group, United Kingdom Atomic Energy Authority. Since the station was officially opened eight months ago experience in operating the plant has been most favourable.

Calder Hall went into operation more smoothly and with less trouble than is normally experienced in starting up a conventional power station. The nuclear behaviour has been good and the critical size was less than calculations predicted. This will be important in connection with the design of future reactors for industrial use.

The Calder Hall reactor was designed with the intention of shutting it down during the periods when fuel elements were being changed. To allow for this routine replacement of fuel elements, and for other maintenance work, it was considered that the reactor would be in operation for only 85 per cent of the hours during the year. Since it first went on load No. 1 reactor has been working for 90 per cent of the time. This is particularly encouraging since stoppages might well have occurred as they normally do in conventional plants.

The leakage of CO_2 from the system is larger than was anticipated but this leakage involves no hazard whatsoever. It is taking place at points such as the glands of valve spindles and is progressively being remedied by conventional engineering methods. Meanwhile, because CO_2 is cheap, the losses will make little material difference to the cost of operating the station.

The performance of the fuel elements has been better than was anticipated. There are a very large number of fuel elements in a reactor, and a small percentage of faulty ones must be expected. This percentage had been established on the Windscale reactors, and by using this information a prediction was made for those at Calder Hall. The usual fault is no more than a pinhole, which leads to a small escape of radioactivity into the coolant gas. This is quickly detected by the leak detection gear, and the element is replaced. The rate of failure to date is lower than the predicted figure, only two elements having failed in eight months.

The most interesting point in connection with the elements which is still under investigation is their deflection or bowing under load. In the Calder Hall reactors the fuel elements are stacked one on top of the other and the lower elements are, therefore, loaded with the weight of those above. On the other hand, because the coolant enters the reactor at the bottom, these fuel elements are at a fairly low temperature.

When the reactor was being designed, the rate at which these lower fuel elements would deflect under load was calculated and found to be satisfactory in the light of the knowledge which existed at that time. Not long before the reactor became divergent, however, it was suggested, as a result of research at Harwell, that the rate of bowing of these lower fuel elements might be greater than had been allowed for. This theory could only be investigated by examination of fuel elements which had been exposed in the reactor. To secure the necessary information the reactor has been closed down on one occasion and fuel elements removed for examination. Although the general condition of these fuel elements is excellent, they show that the Harwell theory is partially correct. This gives rise to no anxiety since it is easy to modify the method of supporting the fuel elements in a way which will give completely satisfactory results.

The fuel elements have been in reactor No. 1 since June, 1956, and since then the Authority's engineers have developed an improved method of support, which will reduce the amount of distortion. This improved type of element has been introduced into reactor No. 2, which is now in full operation. In the near future reactor No. 1 will be due for a routine shut-down and the replacement fuel elements which will then be inserted will be of the modified design.

Letters to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Protective Multiple Earthing

I WOULD refer to Mr. Gilbert's letter in the *Electrical Review* of 25th January. Whilst it is agreed that the danger inherent in protective multiple earthing is associated with the loss of the neutral, this danger arises because the metal connected to the neutral beyond the break has a potential imposed on it *without* the existence of a fault from the phase.

In criticising Mr. Emerson's proposal Mr. Gilbert has to introduce a fault condition which must appear obligingly in an appliance during the period when the neutral is lost, a most unlikely occurrence. Loss of the neutral means loss of supply to the consumer, a condition which is very quickly remedied.

With mains assisted protective devices, isolation of a fault condition is rapid and definite because of the "power" available for operating the trip mechanism. These qualities are not always inherent in a trip mechanism relying only on a weak leakage current for its operation. Most of us are aware of the effects of contamination and corrosion on delicate tripping mechanisms, introducing as they do a far greater risk of non-operation than does the rare and temporary loss of a neutral.

Dartford. H. C. HOBAN.

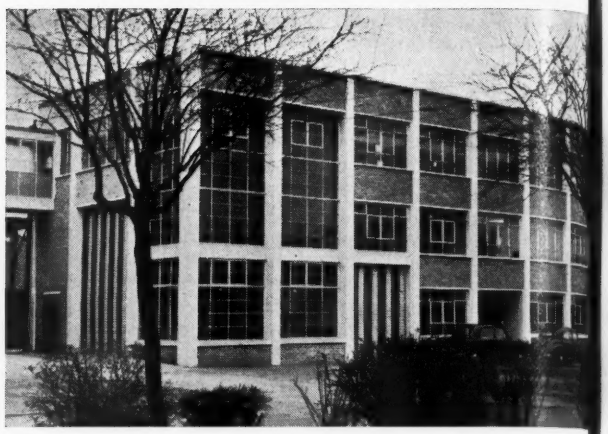
Hydro-Electric Peaks

I REFER to the article "Hydro-Electric Power Stations for Peak Loads," by Mr. C. L. C. Allan, published in the *Electrical Review* of 28th December, 1956. Fig. 1, although admittedly qualified by the statement "typical," indicates a peak load of 370 MW, and it would be of interest to have the relationship of this figure with the figure of 800 MW installed capacity quoted on page 1193 of the same issue.

Also the morning and afternoon peaks are only 100 MW above the daytime level and we wonder if the corresponding figures for the South of Scotland Electricity Board could be obtained to give some indication of the contribution to peak load generation by hydro-electric power as against steam-generated power. The figure of 100 MW is very small when compared with the national output and hence it could surely be expanded by at least fifty times provided transmission costs could be reduced to an economic figure.

London, S.W.1. D. PURVES.

CROMPTON PARKINSON RESEARCH LABORATORIES



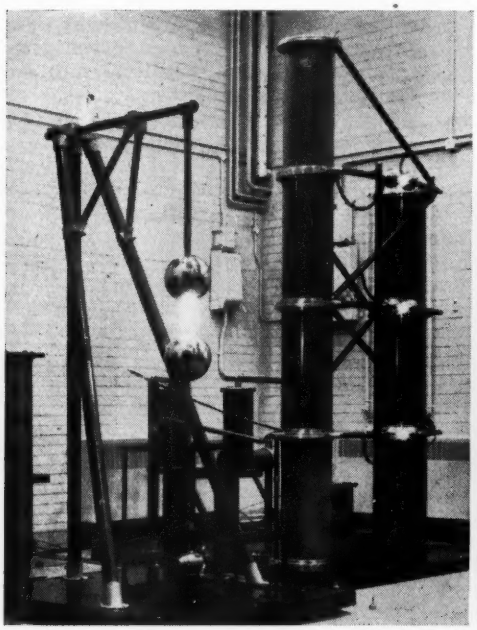
To maintain progress in the technical development of its products, Crompton Parkinson, Ltd., have recently opened a new extension to their development and research laboratory at Chelmsford. The new building provides an additional floor space at 8,000 sq ft. Apart from the new research facilities which are now available, transfer of technical staff to the new premises has also allowed further expansion and improvements to take place in the existing chemical laboratory, workshop and material testing sections. A separate wing on the ground floor has been built to provide a new observation room, improved offices and darkroom for the short-circuit testing station.

The new laboratory includes a high-voltage section housing a 350 kV impulse generator designed and built by the company. This equipment is intended primarily for development work on switchgear and associated equipment, but it will also be available for tests on other products should the occasion arise. At the moment the generator has three stages, but it can be extended to higher voltages if considered necessary. Power frequency testing up to 100 kV is available. Associated equipment in the new laboratory includes a Schering bridge, ionisation detector, transient recorder and control gear, much of this equipment having been designed and built by the department. This new high-voltage laboratory is additional to the existing 2·1 million volt impulse laboratory at the company's B.E.T. transformer works, Hayes, Middlesex.

For dynamic tests on machines and other equipment, a test bed with complete electrical services, a.c. and d.c., has been installed on the ground floor. In the same area a Ward-Leonard set with electronic control has been constructed, and this is intended to be a flexible unit for drives up to 40 h.p.; alternatively, it can be used for supplying a.c. with a high degree of stabilisation of voltage and frequency for special laboratory services. Dynamometer facilities up to 20 h.p. are also provided.

A new and well-equipped microscope room has been built, with its own associated darkroom for photographic reproduction. Apparatus includes a 35 mm camera for use with a microscope and having a built-in electronic exposure meter. Grinding and polishing are carried out in a separate room to prevent abrasive dust damaging the optical equipment. The photographic section has been enlarged and is responsible for a Barcro reproduction process and numerous other photographic applications.

The top floor of the new building accommodates a library and light electrical engineering department which includes electronic and instrument sections. The electronic section is concerned mainly with the development of test and control equipments of a special nature, the staff having recently completed the installation of equipment providing automatic frequency and voltage control of a 35 kVA alternator, to an accuracy of 0·15 per cent. Other examples of development work carried out by this



33 kV impulse generator and (right) the electronic section, showing in the foreground a radio interference test on a fluorescent lamp

section include recurrent surge oscillographs for the company's transformer works and a photo-electric gauging unit for measuring the diameter of extruded plastic or rubber cables.

The instrument section is concerned with the design and construction of special electrical instruments, non-electronic, which may be required for works process control or component testing. An interesting example of the types of instruments developed by the staff is the whole sheet iron tester recently completed for the company's fractional horse-power motor works at Doncaster. This is used for measuring the watts loss in electrical sheet steel before it is stamped into core plates. In addition, the instrument section is responsible for a standards room which has a controlled temperature and is used for checking and calibrating all instruments used by the department.

ENGINEERING AND THE UNIVERSITIES

THE third Graham Clark Lecture was delivered by Sir Ifor Evans, D.Litt. (Provost of University College, London), at a joint meeting of the Institutions of Civil, Mechanical and Electrical Engineers on 7th February. Its subject was the place of engineering in university education. Affirming that a university should be concerned mainly with fundamental disciplines, Sir Ifor expressed his conviction that engineering was as good a discipline as any other, but that there had been an active social and pedantic antagonism to university engineering studies.

The University of London was exceptional in being the first in England to establish a Chair of Engineering (in 1841) and University College was designed to teach engineering from its foundation in 1826. At Cambridge a modern era started in 1890 and for close on 50 years nearly 10 per cent of the whole undergraduate body had been composed of engineers. Although a Chair of Engineering Science was instituted at Oxford in 1907, the old attitude persisted there.

What was needed to-day was not competition between science and the "humanities" but rather the approach of Aristotle and Leonardo da Vinci, that science and the study of man in his environment and of all the arts contributed to a common whole called "civilisation." The universities could contribute only a special and defined share in meeting technological needs without destroying their own nature and purpose. Vague comparisons with the U.S.A. and Russia in regard to the numbers of engineers and scientists were of little value unless related to their useful employment in properly equipped laboratories and industries, but Britain had neither to-day.

The need here was for a greater diversion of consumers' incomes to savings in order to increase industrial output by 4 per cent per annum. The realistic Zuckermann Report of 1956 (which was said, however, to have underestimated the requirements of electrical engineering), said that the number qualifying each year in science and engineering should be increased from the 10,000 of 1954-55 to 20,000 in 1970. Given the right teaching in the schools and adequate funds for laboratories this was not impossible. At University College, London, for example, engineers were only 8 per cent of the students, but there were nine times as many qualified applicants as there were places available. Plans were well advanced (aided by £350,000 from industry) to double the strength of the engineering faculty.

On the other hand, provincial universities last year had 172 places vacant. In some instances vacancies were due to inadequacy of applicants, one major university being unable to accept more than 66 out of 174 applicants for 75 places, which reflected on the teaching of science in schools. The figures would be worse but for the inclusion of students from overseas.

Sir Ifor suggested that industry and the institutions might combine, with the aid of leading public relations specialists, to make more fully known the great opportunities provided by the engineering profession. In the U.S.S.R. academic leaders in engineering had been given prestige and rewards greater even than those of the leaders of industry. Increasing opportunities should be afforded to scientists and engineers of reaching the very top positions in industry.

An advantage of the multi-faculty college was the facilities it provided for meeting students of other kinds of work. An engineer's course must not be confined to engineering; it should include writing business letters, communication of technical information and relevant matters of law. University courses should be broadly based on first principles. The introduction of current practice in the early stages, as in Russia, in place of engineering development as a whole, would be a short-sighted policy here. A healthy industry needed educated men with a knowledge of fundamentals and a capacity for ideas, with a flexibility of outlook that enabled them to put ideas into effect.

The real weakness of university engineering training in Great Britain lay in the weakness of the post-graduate courses. For instance, nuclear development in its application to power would be more of a task for the engineer than for the physicist, who would be helpless without the engineer. The archaic snobbery that had affected university studies in science and engineering had also had detrimental consequences in other aspects of national life. This country might not ever again be a world power, but it could remain a great nation if it used all its resources to take a lead in a new industrial revolution. The attainment of that end would necessitate a profound revision of the whole approach to science and engineering.

Switching Diagrams

THE British Standards Institution has just published the fifth supplement to B.S. 530 : 1948, "Graphical Symbols for Telecommunications." This provides functional symbols for switching diagrams, with particular application to electronic circuits. It is based on the recommendations drawn up by the Post Office Terms and Symbols Committee with the help of a number of experts who were invited to co-operate in this work.

Developments in electronic techniques have led to a corresponding requirement for new symbols for the representation of circuits and, in particular, to indicate the functional operation of circuits without the use of descriptive notes. The system of functional symbols in Supplement No. 5 provides a circuit designer with means of indicating the logical programme of any circuit, electronic or electro-mechanical, regardless of the components used. The supplement is also intended to help students or maintenance staff to follow the operation of electronic circuits without having to refer to circuit operation notes. Copies of the new publication may be obtained from the B.S.I., 2, Park Street, London, W.1, price 2s 6d.

INDUSTRIAL NEWS

Electronics Exhibition

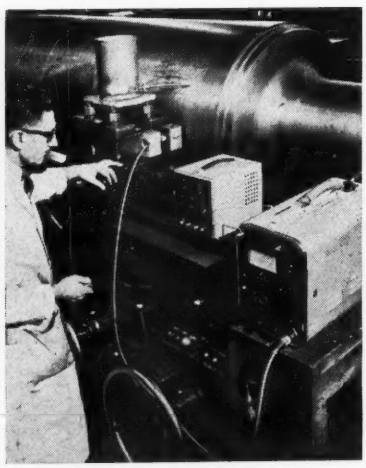
An exhibition is to be held in the College of Science and Technology, Manchester, on 26th and 27th March next under the auspices of the Radio and Telecommunications Group of the North Western Centre of the Institution of Electrical Engineers. It is intended to stimulate recruitment to the electrical engineering profession. Demonstrations of working electronic equipment will illustrate the type of work undertaken by those choosing electronic engineering as a career. Apparatus of many kinds will be shown in operation, illustrating some of the ways in which electronic devices can be used to solve problems of research and industry. Whilst primarily intended to interest young people in the electrical engineering profession, the exhibition also sets out to give some idea of what can be done to-day by means of electronic techniques. There will be no charge for admission.

Testing Rotor Forgings

An automatic method of testing rotor forgings for internal faults is being investigated by the General Electric Co., Ltd., at its Witton works, using a Solus-Schall ultrasonic flaw detector in conjunction with a monitor. The rotor is mounted in a lathe with the probe of the flaw detector in the tool rest. As the rotor is slowly revolved, the probe traverses its full length. Any internal fault causes a light to appear on the monitor and the attendant marks its position on the forging. Alternatively, provision is made for an audible warning to be given. Subsequently, any faults discovered by this preliminary scanning are explored fully by hand methods to establish their precise nature.

In addition to the advantage of a 100 per cent coverage, the operator is relieved of the strain imposed by continuously watching the trace on a cathode ray tube. Furthermore, the time necessary to conduct a full examination of a forging is reduced considerably.

A further development of this system which is now being considered, is the provision of electronic apparatus whereby the position of any fault in the rotor is marked automatically. It is expected that this would also enable the speed of scanning to be increased.



Automatic method of flaw detection in a turbo-alternator rotor forging

Electricity in Farming

Some of the ways in which electricity helps the farmer, and in particular helps him to beat the weather, have been shown this week in the electricity exhibit organised jointly by the British Electrical Development Association and the South of Scotland Electricity Board at the Scottish Dairy Show at Kelvin Hall, Glasgow. An E.D.A. scale model of a grain drying installation has been on display supported by enlarged photographs of plant in use in different parts of the country.

Actual equipment shown on the stand has included a multi-purpose crop dryer suitable for a 20-hole platform, a cold blow barn hay dryer, a 20-hole platform grain dryer and a silo ventilating unit suitable for six ten foot diameter silos of 910 sacks capacity. Examples of various makes of meters for measuring the moisture content of grain have been exhibited, and there has been a working exhibit devoted to electrical equipment for grain handling and conveying, including a conveyor-elevator and an auger type conveyor.

Edinburgh Electrical Showrooms

Three electrical concerns in Edinburgh have recently extended or modernised their showrooms.

James Scott & Co. (Electrical Engineers), Ltd., have opened a major extension to their Morrison Street premises; two adjoining corner shops have been taken. The older shop has been devoted to television with a stairway leading down to the basement secondhand section which is a new development for Scott's. The rest of the ground floor is designed to provide quick service for lamps, accessories and other smaller items; this is done on open access self-service lines. The rest of the ground floor taking in the corner area is devoted to demonstrations of washing machines, cookers and similar appliances.

J. B. Mackenzie (Edinburgh), Ltd., of Hanover Street, have completed the modernisation of their premises; this has been done while retaining the Georgian character of their property. The inquiries section acts as a focal point which directs customers to the reception and information area. The rest of the floor has been left clear for floor displays of appliances while one section has been devoted to a quick-service fixture for lamps and fittings.

William Renton and Sons, of 57/59, Clerk Street, have doubled their showroom and office accommodation, and added substantially to their basement workshops by taking in an adjoining shop and linking the two to form a large modern showroom. The new showroom is largely devoted to the plumbing side of the business but in making this change the electrical side has benefited equally. The limited window space has been expanded from one window to three, one of which is devoted to electrical appliances and equipment.

Railway Components Exhibition

A trade exhibition of the wide range of components necessary for the British Railways' heavy programme for the fitting of wagons with continuous brakes under the Railway Modernisation Plan is to be held at Euston Station from 18th February to 1st March. The provision of components to enable this programme to be carried out will mean heavy demands on industry in 1958 and subsequent years, and may require much greater capacity than can be provided by firms normally engaged in railway contracts of this kind. The Commission has, therefore, decided to widen the field of its inquiries, and has arranged this exhibition of the components. The exhibition will be held in the Central Offices, Room 155, Euston Station, N.W.1. Admission will be by ticket only, obtainable on application to Mr. E. R. Sambridge, Chief Stores Officer's Department, B.T.C., Room 156, Euston Station, London, N.W.1 (telephone: Euston 1234, Extn. 8274). The exhibition is being arranged solely for manufacturers' representatives and will not be open to the general public.

Modern Metals Protection

Although promising solutions to many technological problems, some of the new metals and alloys now becoming available, like titanium, zirconium and nimonic and even stainless steels sometimes present severe difficulties to the metal worker in production, especially during cold processing.

In overcoming these difficulties, phosphate, oxalate, and other allied organic and inorganic coatings in the "Bonderizing" range are playing a part of great importance; indeed they have made an operation previously considered impossible a matter of thoroughly economic mass production routine. Further significant advances have been made in the application of "Bonderite" coatings to very deep

drawing operations, to the cold extrusion of steel and to cold heading. Something of these developments in manufacturing technology is told in the pages of the special issue of "The Bonderizer" published by the Pyrene Co., Ltd., Great West Road, Brentford.

Sales Conference

Agents, technical staff and sales staff of Austinlite, Ltd., held a sales conference recently at the company's new factory in Crawley, Sussex. The conference discussed the various aspects of rotary switch sales and service and the meeting analysed a number of typical problems submitted by customers. The newest developments and additions to the Austinlite range were also discussed.

Sudanese Broadcasting Station

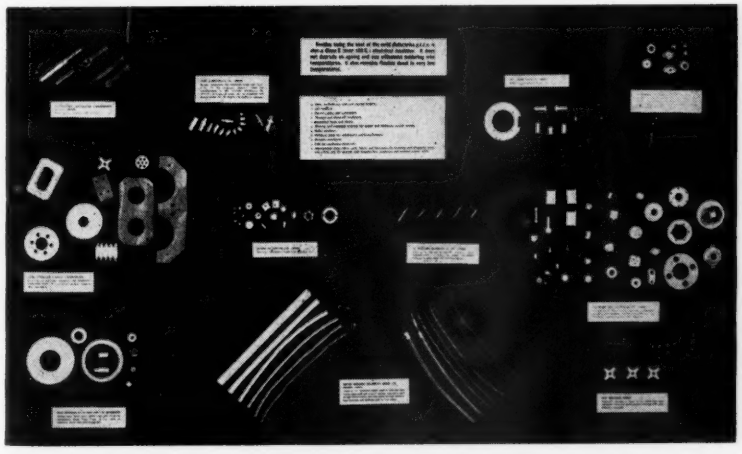
Another radio station in Africa is to be equipped by Marconi's Wireless Telegraph Co., Ltd. The Sudan Posts and Telegraphs Department has placed an order with the company for transmitters and studio equipment to a value of approximately £100,000 for a new broadcasting station at present under construction at Omdurman, not far from Khartoum. It is planned to bring the station into partial use early this year. Marconi's will supply two 20 kW h.f. transmitters, as well as aerials and studio equipment for the new Broadcasting House at present under construction.

Industrial Application of "Fluon"

The Plastics Division of Imperial Chemical Industries, Ltd., recently held an exhibition in London showing the latest industrial applications of "Fluon" (polytetrafluoroethylene). This relatively new thermoplastic material is now being made on a commercial scale by I.C.I. Because of its high softening point and outstanding resistance to moisture and most chemicals, "Fluon" is rated as the best of the solid dielectrics and is also a Class C (over 180 deg C) electrical insulator. It does not degrade on ageing and can withstand soldering iron temperatures. It also remains flexible down to very low temperatures.

In the electrical industries p.t.f.e. is now being extensively employed for radar windows; film for condenser dielectrics; valve, cathode-ray tube and crystal holders; coil formers; coaxial cables and connectors; insulating tapes and sheets; and for sleeving and extruded covering for power and electronic circuit wiring; antennal insulators, etc.

Some of the electrical applications of "Fluon"



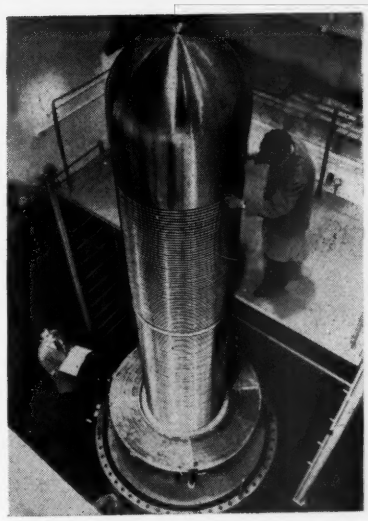
Import Certificate Amendment

The Board of Trade has made the Control of Goods (Import Certificate) (Amendment) Order, 1957 (S.I. 1957 No. 142), amending the form of import certificate which is required in connection with the international control over the movement of strategic goods. There are two main changes. Provision is made for cases in which the intention of the applicant is to send the goods direct to a third country under a Board of Trade licence, and for the certificate to specify the period within which it must be presented to the authorities of the exporting country. The Order is obtainable from H.M. Stationery Office, price 5d by post.

Electrostatic Generator

A very high voltage Van de Graaf electrostatic generator has been installed at the Aldermaston Atomic Weapon Research Establishment. In this machine a continuous non-conducting belt carries an electrostatic charge from the bottom of the machine to the polished dome at the top where the potential can be built up to as much as six million volts.

The value of the potential can be varied by changing the potential at which the charge is sprayed on at the bottom. The final potential, which can be mainained constant to ±1 kV, is used to accelerate beams of protons, deutrons and the like to high energies. These ions are produced in the top dome and they are accelerated down through the column to emerge in the room beneath.



Six million volt electrostatic generator at Aldermaston

The constant energy beams of particles produced in the generator are used to bombard different materials, thereby initiating nuclear reactions, and leading to a better understanding of the nature of the atomic nuclei. Features of the machine are the narrow spread of particle energies (1 kV in 6,000 kV) and the column section resistors (the ribs in the column).

Teaching Production Engineering

The report of a conference held from 22nd to 26th April, 1956, at the Technical University, Delft, Holland, is now available from the Institution of Production Engineers, 10, Chesterfield Street, London, W.1, price 3s 6d. It refers specifically to the education of production engineers within universities. There are four sections which deal with the meaning and extent of production engineering training as considered by the conference; the co-ordination of industrial work and university study as practised on the Continent; production engineering studies and the composition of courses; and post-graduate courses.

First Aid in Industry

The heavy toll of accidents in industry is a serious handicap to the national economy. One way of reducing absence due to accidents is the establishment of an efficient first aid organisation to supplement any other medical arrangements which may exist. The St. John Ambulance Association, the St. Andrew's Ambulance Association and the British Red Cross Society have jointly sponsored a new textbook entitled "Occupational First Aid" which outlines the responsibilities and duties of trained first aid workers in industry, and is intended for study by holders of first aid and home nursing certificates. A syllabus for an occupa-

tional first aid course is included. Copies of the textbook can be obtained from the St. John Ambulance Association, St. John's Gate, Clerkenwell, London, E.C.1, price 2s (2s 2½d by post).

British Railways Contracts

The following are among contracts recently placed by the Scottish Section of the British Railways:—

Provision of colour light signalling apparatus, main and stand-by electricity supplies, and compressed air services, Glasgow Central High Level; and electricity supplies, compressed air services, retarders and hump yard equipment, new marshalling yard, Perth.—Westinghouse Brake & Signal Co., Ltd.

Main line colour light signalling apparatus and relay interlocking control panel, Millerhill Marshalling Yard, Edinburgh. — Metropolitan - Vickers - GRS, Ltd.

Colour light signalling, relay interlocking control panel, main and stand-by electricity supplies and compressed air services for the new marshalling yard, Perth.—Siemens & General Electric Railway Signal Co., Ltd.

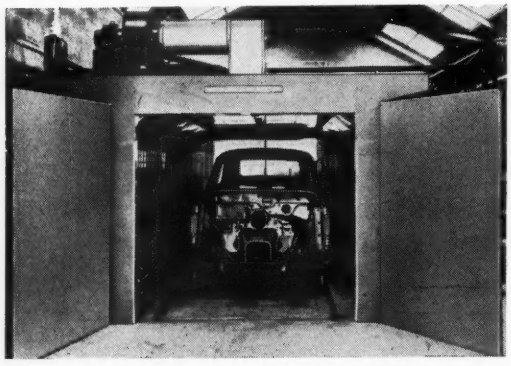
Two overhead electric travelling cranes, Townhill Junction Wagon Repair Depot.—Paterson, Hughes Engineering Co., Ltd.

Track recording trolley, Scottish Region.—Matisa Equipment, Ltd.

Infra-Red Cellulose Drying

An infra-red plant has been installed in the works of Booth, Poole & Co., Ltd., Dublin, by the Metropolitan-Vickers Electrical Co., Ltd., which is the first of its kind in use in Eire. It is suitable for accelerating the drying of complete car and van bodies after spray painting with cellulose-based paints. The oven is 19ft 6in long, 10ft 6in wide and 7ft 2in high, consisting of an angle iron framework sheeted on the outside, to form a continuous skin, which is heat insulated on the inside. An inner framework carries the anodised aluminium reflectors, which form a continuous inner skin, on the sides and bottom of which are mounted the 80 special "U" bent Metrovick infra-red elements with a total loading of 140 W. Each element consists of a spiral of high grade resistor wire tightly embedded by a special process in magnesium oxide encased solidly in an outer sheath of $\frac{5}{16}$in diameter tube of non-scaling, non-corrodible alloy. Control of the heat in the oven, both as regards intensity and distribution, is effected by means of "Sunvic" energy regulators operating in conjunction with contactors carrying the load current in the four main sections of the heaters which are fitted in the sides, ends, top and bottom of the oven. The temperature control gear as well as the main switch fuse, fan motor starters, push buttons and fuses are all housed in a control cubicle attached to the oven at the end remote from the spray booth, thus removing the necessity for flameproof gear (the distance between the control gear and the spray booth being in excess of the regulation 20ft). The wiring of the control gear is such that it is not possible to switch on the elements without the fans running.

"Metrovick" infra-red plant drying cellulose on car bodies



Conferences on Planning for Industry

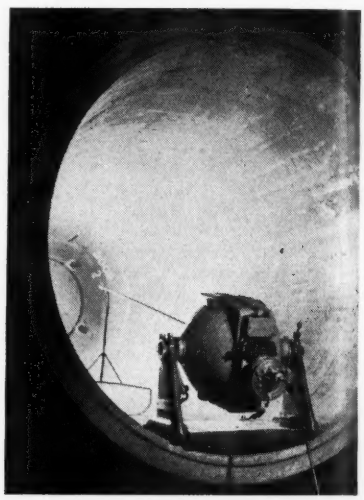
Three separate conferences on management principles and practice will be organised this spring by the British Institute of Management. Each of them is designed to provide a cross-section of the best national resources of knowledge and experience in management subjects. The programmes of each of the conferences will be built around themes relating to management's responsibility for planning ahead and for speedy implementation of policy. Dates of the conferences are as follows:—22nd to 24th March at Southport; 5th to 7th April at Droitwich; and 3rd to 5th May at Gleneagles. Particulars of the conferences can be obtained from the Institute, 8, Hill Street, London, W.1.

Indian Electrical Year Book

The 1956 edition of the "Indian Electrical Year Book" reflects the rapid strides which are being made in the Indian electricity supply and electrical manufacturing industries. The nine sections of the Year Book have been completely revised and include information on electrical manufacturing developments and a review of power generation schemes under the first five-year plan and under the second plan. The directory sections include the names and addresses of electrical manufacturers, contractors and traders, an alphabetically arranged buyers' guide and a list of electrical associations in India. The whole forms a useful guide to the electrical position in India, although we note that in the preface it is stated that electricity production rose from 6,120·3 million kW in 1952 to 8,782·4 million kW in 1955. These figures refer, of course, to kWh produced and this is made clear in the statistical section of the book. The Year Book is published by M. Largo-Afonso, 75, New Stock Exchange Building, Apollo Street, Bombay, 1, price 25s.

Radiographic Inspection

Radiations emitted by radioactive isotopes are often eminently suitable for non-destructive testing of welds, castings and assemblies. Avoidance of costly breakdowns and savings in material and labour costs are some of the advantages gained by using radiographic inspection.



Pantatron III radiographic unit

The Pantatron III, made by Nuclear Engineering, Ltd., of Greenwich, is a large isotope radiographic unit, operated by remote control for safety. Cobalt 60 produced in a nuclear reactor at Harwell is used as the source of radiation energy. A large source (10 curies) costs about £60 and is useful even after 15 years' decay. The penetration of Cobalt 60 for radiography is from 1in to 8in of steel.

Audio Repeaters for the Irish Post Office

An order for transistorised two-wire repeaters has recently been placed with Standard Telephones & Cables, Ltd., by the Irish Post Office for use on loaded junction cables in its telecommunications network.

Generating Sets for U.S. Army

A substantial order for a large batch of generating sets, with spares, has been placed by the U.S. Army, Signal Procurement Centre, Frankfurt-am-Main, with Henry Meadows, Ltd., for

operational military use overseas. The order has been placed under offshore procurement arrangements for N.A.T.O. countries, and more than half of the total number of units have already been dispatched abroad.

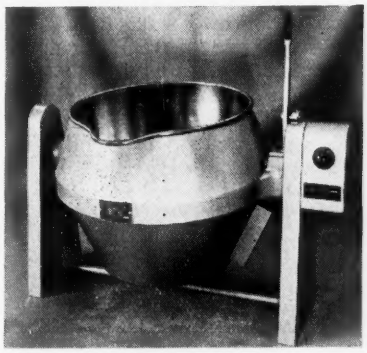
N.C.B. Specification

A revision of N.C.B. Specification No. P 139/1956, "Rubber Insulated Armoured Cables for Power, Lighting and Control," is now available from the National Coal Board, Production Department, Hobart House, Grosvenor Place, London, S.W.1, price 3s.

Electric Boiling Pan

Jacketed boiling pans are used in a variety of industries and recently there has been an increasing demand for electrically heated vessels of all kinds owing to the cost of installation of a steam-raising plant and the need for labour to attend it. In conjunction with William Brierley, Collier & Hartley, Ltd., confectionery manufacturers, the Stabilag Co., Ltd., of Hemel Hempstead, decided to produce an electric jacketed tilting pan and tests with a prototype unit were a complete success. All the modifications that the toffee manufacturers suggested were incorporated and the loading has now been slightly raised to bring the electric jacket unit into line with its steam equivalent.

A splash guard around the pouring lip prevents ingress of contaminating



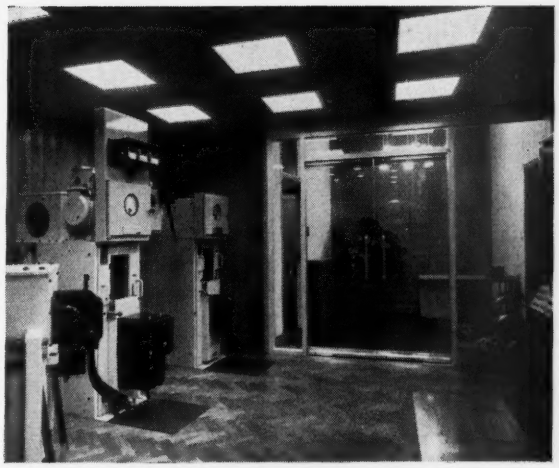
New electric jacketed boiling pan p roduced by the Stabilag Co.

materials into the heater, and all electrical and mechanical parts are easily accessible for maintenance. The cost is little more than that of an equivalent steam jacketed vessel. No insurance test is required (as would be the case with a steam jacketed unit), thinner gauge materials can be used, and the vessel can be made portable. The electrically heated pan is easier to clean because it is single cased and not a welded fabrication as is the steam jacketed type.

Manufacturing Progress in 1956

In the account of the activities of the English Electric Co., Ltd., in our issue of 11th January, an error was inadvertently made. We said that the order for the South Durham Steel & Iron Co., Ltd., was for six 6,500 kW, back pressure machines; this should have read six 6,500 kW sets, three of which are back pressure machines operating at 600 lb/sq in, 825 deg F, with 190 lb/sq in back pressure, and three condensing sets operating at 185 lb/sq in, 585 deg F.

We regret that by the omission of decimal points three errors occurred in our review of the activities of Ferranti, Ltd. (1st February issue). On page 205 the test equipment for B.I.C.C., Erith, referred to as of 24 MVA capacity is actually 2·4 MVA. Similarly test equipment for Enfield Cables was described as 16 MVA instead of the correct figure of 1·6 MVA and equipment for the Anaconda Wire & Cable Co. was given as 24 MVA (2·4 MVA).



New showroom at the London office of Johnson & Phillips, Ltd.

Indian Import Licensing

In the *Board of Trade Journal* for 2nd February details are given of the import licensing arrangements made by the Government of India for the first half of this year. The schemes for the licensing of capital goods and heavy electrical plant are continued in force and details may be obtained from the Export Services Branch (Tariff Section), Board of Trade, Lacon House, Theobald's Road, London, W.C.1.

E.T.U. Conference

The annual policy conference of the Electrical Trades Union is to be held this year at Folkestone. It will take place in the Leas Cliff Hall during the week commencing Monday, 3rd June.

"Blue Book"

The 1957 edition of the Electrical Trades Directory — the *Electrical Journal* Blue Book—now available, is the 75th publication of this directory. Its general arrangement is similar to that of previous editions, but with the growth of material available and the increase in the number of entries, some restrictions have had to be made to keep the volume to a manageable size. All the main sections, with one exception, are retained—the exception being the "Personal" section, as much of this information is given elsewhere in the directory. The sections cover the whole of the electrical field—electricity supply, manufacturing, contracting, wholesale, consulting engineers, trade associations, institutions, colleges and schools, etc., and the trade names section has been enlarged and now contains nearly 6,000 entries. The directory is published by Benn Brothers, Ltd., Bouverie House, Fleet Street, E.C.4, at £3 3s carriage paid.

New J. & P. Showroom

Johnson & Phillips, Ltd., have opened a new showroom at their London office, Columbia House, Aldwych, W.C.2. A range of switchgear, capacitors, and cables is on show and in a separate section the domestic appliance products of British National Electrics, Ltd., are displayed.

Trade Announcements

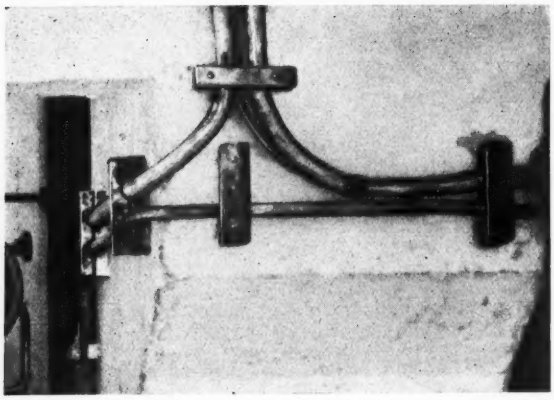
Thorn Electrical Industries, Ltd., has appointed Mr. A. Marshall, of Glenrothes, Fife, as "Atlas" representative for the North East of Scotland. Mr. Marshall was formerly with Wilkins & Mitchell, Ltd., as a representative for "Servis" washers.

The **Hotpoint Electric Appliance Co., Ltd.,** has appointed the **Edison Swan Co., Ltd.,** at 12, King Street, Belfast (telephone: Belfast 20549), as its agents in Northern Ireland for all Hotpoint, "Coldrator" and "Premier" products, and at 41, Ward Road, Dundee (telephone: Dundee 3129), as agents for these products in the area of the North of Scotland Hydro-Electric Board with the exception of the Dalriada and Cowal areas.

Grelco, Ltd., Minehead, Somerset, announces that Mr. L. Hudd, of 23, Church Road, Kelvedon, Colchester, has been appointed selling agent for multiplug adaptors in the Eastern counties including Cambridge, Essex, Kent, Lincoln, Norfolk and Suffolk.

Mercia Enterprises, Ltd., Opera House Buildings, 30, Silver Street, Coventry, have been appointed sole concessionaires in Great Britain and Northern Ireland for the A.E. low-voltage stabilisers manufactured by l'Accumulateur Etanche S.A., Brussels.

Panelec (Great Britain), Ltd., has removed to 21, Bloomsbury Street, London, W.C.1 (tel.: Langham 4234).



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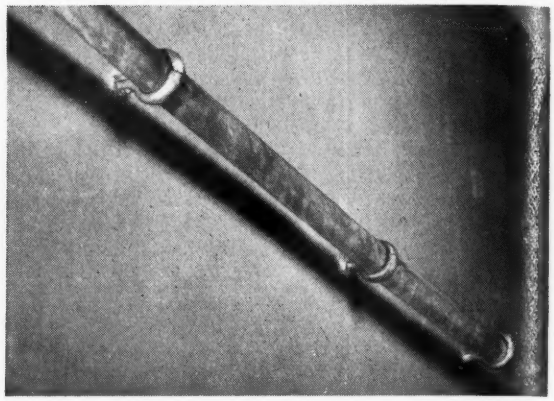

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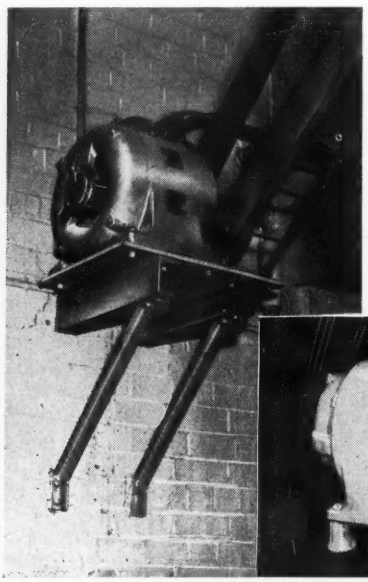
Food Factory Installations

Poor and Good Practice in the Design of Equipment



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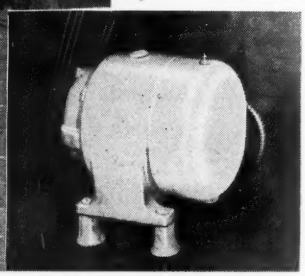

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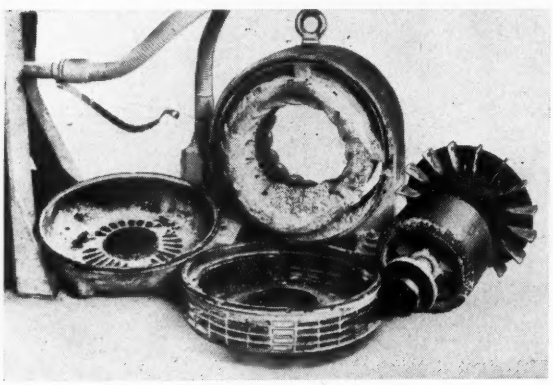
TWO booklets—" The Installation of Machinery, etc., in relation to the Control of Insect Pests " and " The Design of Machinery and Plant in relation to the Control of Insect Pests " have been issued by the British Food Manufacturing Industries Research Association with the aim of encouraging improved design in food factory machinery and to emphasise the importance of producing and using equipment which can be cleaned and maintained easily.

The story in each case is told almost entirely by illustrations of bad and good examples of various practices, and some of the illustrations of electrical equipment and practice have impressed us forcibly because of their practical note. We think there is no need for us to do more than print the accompanying selected illustrations.

1. Bad arrangement of cables, leaving ledges and pockets in which food dust can collect and moth eggs be laid. **2.** *Electric cable, armoured and served finish, supported on pipe clips clear of wall*

3. *Wall-mounted motor with undesirable features; it is very inaccessible for cleaning and too close to the wall, and the channel iron supports and horizontal plate provide traps for dust.* **4.** *Enclosed type motor mounted on bobbins*



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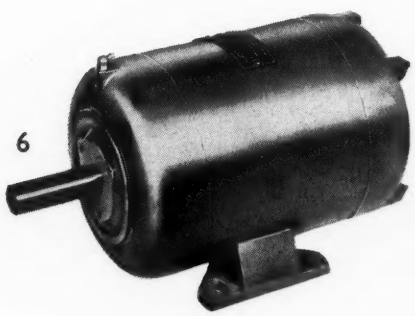

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5. *S.c. motor taken apart to illustrate the accumulation of food material and dust that can occur when these motors are used in an open workroom.* **6.** *Totally enclosed motor*

GENERATION AND DEVELOPMENT

Sales of New Domestic Appliances

The accompanying table shows the number of new appliances sold by Area Electricity Boards in England and Wales in the year as well as the quarter ended 31st December last, together with percentage changes over corresponding periods of the previous year. When assessing the figures, it must be remembered that the sales by Area Boards represent only a part of total sales throughout the country.

	Sales in quarter ended 31st December, 1956		Sales in twelve months ended 31st December, 1956	
	Total	Per cent change over corresponding period of previous year	Total	Per cent change over previous year
Cookers	57,371	0·0	206,742	— 15·2
Water heaters—				
Immersion	20,850	— 10·3	133,673	— 18·0
Storage	10,039	— 3·0	42,173	— 32·3
Wash boilers	17,199	+ 25·6	61,870	— 2·7
Washing machines	17,065	— 46·9	71,642	— 54·2
Refrigerators	4,662	— 45·5	32,111	— 40·6

Further Evidence at Scottish Inquiry

On the fifth day of the inquiry into the South of Scotland Electricity Board's plan to build a nuclear generating station at Hunterston, Mr. J. Henderson, chief engineer of the Board, was asked by Mr. C. H. Johnston if the Board had made alternative arrangements should the station not be completed in 1961. Mr. Henderson said that if permission were refused the Board would have to take action fairly quickly. It might consider building the second half of Kincardine power station or providing a nuclear generating station on another site. Questioned further, he said that the Hunsterton project fitted into the Board's programme and also into the Government's programme for nuclear energy. Three other sites had been passed by the Atomic Energy Authority, but any one of these, if put forward, would almost certainly have to be the subject of an inquiry. It was doubtful if they could get into commission in time if they had to go through the process of a public inquiry again.

On 5th February Mr. D. W. T. Angwin, chief constructional engineer of the Atomic Energy Department of the General Electric Co., Ltd., stated that the labour force on the project would rise from 300 to 2,000 in the second year, and reach a maximum of 2,200 in the third year.

Mr. L. H. Baker, a consulting civil engineer, defending the choice of the Hunterston site, said that agricultural land was lost to all kinds of construction of far less importance than a nuclear power station. He agreed that Turnberry was a practicable site. However, if the Turnberry site was surcharged with heavy outlay in transmission costs, Hunterston would become the site which should be taken up, other things being equal.

Mr. Howard V. Lobb, executive architect for the station, told the inquiry on the following day that the station would be, in effect, a massive "glass-house." The space between the silver-grey bricks on each floor would be filled with glass. In parts it would be possible to see in one wall and through the opposite one to the hills beyond. In a vertical direction there would be about 150ft of glass walls. A project of this kind and on this scale required for its proper siting a dominating landscape and seascape which would, as it were, absorb the station group so that it was part of the whole landscape. The beauty of the site would be preserved.

Miss E. Hunter, one of the objectors, said that if the station was built on the site proposed it would be quite impossible for her to carry out her farming programme to the same extent. She would find it difficult to decide whether she could morally allow milk to be sold from a dairy herd so close to a nuclear power station. But her main objection was on the national level. Other national interests such as agriculture and amenity should be considered.

Mr. A. T. MacIndoe, a Scottish planner, said that the land at Hunterston included some of the most fertile in Ayrshire and Mr. John J. M. Hannah, a spokesman for the National Farmers' Union, said that the land was in one of the few areas in Scotland where early potatoes could be grown.

The evidence was concluded last Friday. Sir Randall Philip, Q.C., who has conducted the inquiry, inspected the Hunterston site on Saturday and on Monday he visited alternative sites, including Turnberry and Culzean Bay.

Holy Island Supply

In reporting on the proposed supply to Holy Island in last week's issue reference was made to the North Eastern Electricity Board; this should have been the South of Scotland Electricity Board. By agreement between the former South East Scotland Board and the North Eastern Board in 1948 an area of some 144 square miles in North Northumberland was supplied by the S.E. Scotland Board, whose duties have now been taken over by the South of Scotland Board.

No Gas for Prudhoe Estate

Prudhoe (Northumberland) U.D.C. has decided that 410 houses to be built on the West Wylam housing estate shall be supplied only with electricity. The Council took a census recently to find out whether tenants favoured gas or electricity. Although opinion was divided on the matter, the Council decided to supply only electricity.

County's Electricity Costs

Somerset County Council estimates that it has saved £8,500 a year in electricity costs as the result of a review of the terms of supplies carried out by the county treasurer. Reporting on this, the County Finance Committee says that the large number of factors involved calls for a very careful judgment as to which tariff is likely to be the most economical in any particular case.

Towards the All-Electric House

The Merseyside and North Wales Electricity Board has a Development and Research Department which is responsible for creating and developing new ideas in electrical equipment, especially of the kind that can be of service to the housewife. On three days recently at Vauxhall Road, Liverpool, representatives of the Press, architects and others were shown what is being done in this direction.

It was explained that electricity generated from nuclear energy would probably become the principal means of space heating and this would lead inevitably to the all-electric home. New methods of heating were therefore prominent among the exhibits. Infra-red heaters were shown in different stages of development and an interesting combined heating and lighting unit, incorporating infra-red heat, the prototype of which is being tested in a Liverpool church, was displayed. Mr. W. Gilchrist, A.M.I.E.E., M.I.H.V.E., chief commercial officer of the Board, told the representatives that two blocks of flats and maisonnettes now being built at Birkenhead would be electrically heated by floor warming, with infra-red heaters in the bathroom and kitchen. Other prototype equipment shown included block storage heaters.

An item of equipment which

attracted particular attention was an all-in kitchen unit which is being developed in collaboration with the English Electric Co., Ltd. About 8ft long, the plywood cabinet is intended as permanent built-in equipment, and when completed it is hoped to incorporate a cooker, washing machine, sink and refrigerator. The sink will have a refuse disposal unit which will grind up all normal vegetable refuse, bones, etc., and pass these through the drains.

Installations in Pre-War Houses

Tenders are to be obtained by Boldon (Durham) U.D.C. for the installation of electricity in Council houses built some 30 years ago.

Trolley-Bus Abandonment

Provided petrol rationing is ended by then, Darlington Town Council expects to replace its last trolley-bus service, on the Neasham Road-Faverdale route, with motor buses by the end of the summer.

OVERSEAS

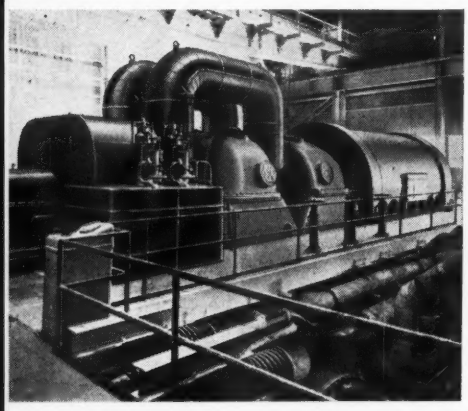
American Atomic Power Station

The New York correspondent of *The Times* reports that a group of mid-western public utilities in the United States and the Allis-Chalmers Manufacuring Co. plan to construct within five years an atomic generating plant designed to be competitive with "conventional" power plants. The station is expected to cost between $20 and $25 million and will have a capacity of 60 MW. It is expected that the Allis-Chalmers Co. would spend two years on research and development before beginning the construction of the plant.

Alberta Plant Extension

A 66 MW Metropolitan-Vickers three-phase 60 c/s 13·8 kV turbo-generator running at 3,600 r.p.m. has recently been commissioned at the Wabamun power station of Calgary Power, Ltd. The turbine is designed for initial steam conditions of 850 lb/sq in gauge, 900 deg F, and was supplied complete with condensing plant and feed heating equipment. The generator is hydrogen-cooled.

A 66 MW Metropolitan-Vickers set recently commissioned at the Wabamun power station of Calgary Power, Ltd., Alberta



Australian 330 kV Switching Station

Construcion of a major power distribution centre at Yass, of which the initial development will cost £2 million, will be started shortly by the New South Wales Electricity Commission. The new centre will combine the functions of a switching station for the new 330 kV transmission system, and a substation to step down the voltage for distribution throughout the south-west of the State. The 330 kV transmission system, already under construction, will interconnect the Snowy Mountains hydro-electric stations with the major thermal stations of the N.S.W. coalfields. This will be the highest voltage yet to be used in Australia. The first section, temporarily operating as part of the 132 kV system, links Goulburn with Tallawarra power station (near Port Kembla). A second section between Goulburn and Yass is now under construction, and next year the line will be extended to the Tumut area to connect with the first of the major hydro-electric stations of the Snowy scheme. It will also continue to Sydney, Lake Macquarie, and the north-west of the State.

Extensions of the 132 kV system from Wagga both to Albury and to the Murrumbidgee irrigation area are in progress, and surveys are being carried out for the construction of further new sections between Cowra and Forbes (to begin this year) and between Yass and Cowra. The existing Yass-Cooma line will be connected to a new substation being built at Queanbeyan to supply the surrounding district, including Canberra. Yass will also be developed as a major depot for the south-west area, and the building plans include the construction of new workshops and offices from which maintenance and repair work will be supervised.

Water Power Supersedes Wood

The Kiruba Island wood-fired power station of the Uganda Electricity Board has been shut down and sold, and electricity is now supplied from the hydro-electric station at Owen Falls. A causeway connects Kiruba Island to the mainland near Gaba, some six miles from Kampala.

The power station, constructed in 1938 by the East African Power and Lighting Co., provided the first public supply of electricity in Uganda and, until the diesel station at Lugogo in Kampala was commissioned in 1949, was the only source of power for Kampala and Entebbe. The first African to become chargeman was Bulasio Bukalamuli, who is still employed by the Board and who in 1954 was presented to the Queen at the Owen Falls opening ceremony.

Electrical Housecraft Advisers' Conference

About 400 women representatives from Electricity Boards throughout the country, will attend the annual four-day Conference of Electrical Housecraft Advisers and Demonstrators, which begins in London on 12th March. The conference, which is organised jointly by the Electrical Development Association and the Electrical Association for Women, will be held at the Victoria Halls, Bloomsbury Square, London, W.C.1.

Mr. D. Bellamy, chairman of the E.D.A. and chairman of the Yorkshire Electricity Board, will open the conference. He will introduce Miss Mary George, director of the E.A.W., who was appointed to that post last year. The programme will include a lecture by Mr. U. F. Murray, assistant chief commercial officer, South of Scotland Electricity Board, on "The Domestic User of Electricity." Miss B. A. Crang, head of the domestic food preservation section of Bristol University Research Section, Long Ashton, will speak on "Making and Judging Bottled Fruits, Syrups and Jams" and also "Home Freezing." On Wednesday (13th March) the subject will be "Electricity Through Life," a programme arranged by Miss M. B. Marris, senior housecraft adviser, South Wales Electricity Board, Cardiff, with the co-operation of other Area Electricity Boards. The afternoon session is called "Demonstrate to Sell" and will incorporate a selection of ideas from manufacturers' housecraft advisers. On Thursday morning, at the West London College of Commerce, Mr. H. G. F. Gamble, assistant chief commercial officer, Eastern Electricity Board, Ipswich, will speak on "What to See at the Ideal Home Exhibition." This will be followed by a visit to the Exhibition.

The Connaught Rooms, Kingsway, W.C.2, will be the venue for the final day's proceedings. Mr. D. C. Lucia, deputy director, City and Guilds of London Institute, will address the conference on "City and Guilds Examination and Requirements." General discussion will then follow, after which there will be a luncheon.

Wholesalers' Stocks

During next week the Board of Trade will be inviting about 1,200 companies trading wholesale to provide figures of the value of their stocks and capital expenditure on a voluntary basis each quarter. This is part of the Government's programme for improving existing sources of information about the economic situation.

NEW ELECTRICAL EQUIPMENT

Cooker Control Unit

The "Master" 30 A cooker control unit, with 13 A subsidiary circuit, previously available with a metal cover, is now offered by BILL SWITCHGEAR, LTD., Aston Lane, Perry Barr, Birmingham, 20, with an insulated cover for both the surface and flush patterns. The normal finish is in ivory but cream can be supplied on request.

External dimensions of the steel box are 6¼in high by 5⅜in wide by 2 1/16in deep, and the weight, including one 13 A fused plug, is 2½ lb. The unit is available with or without pilot lamps. The price of the cooker switch illustrated (type M30/D13) is £1 12s 4d.

Fume Cupboard Fans

The method of protecting fans against corrosive gases by a coating of polythene developed by WOODS OF COLCHESTER, LTD., Braiswick Works, Colchester, is now applied to "Aerofoil" fans designed for fume cupboards. The new fans, made in 6, 7½ and 9½in diameter sizes, are completely protected with polythene inside and out. The motor and casing are hermetically sealed in a corrosive resistant covering. To ensure adhesion of the polythene to the fan the casing is made from perforated steel and is coated on both sides.

The fan impellers are phenolic mouldings and the hubs are designed to shield the motor against the ingress of fumes through the spindle bore. The motors are fitted with a "breathing" tube which passes through the casing.

The two smaller fans are driven by a new 2-pole shaded-pole motor, developed by Woods of Colchester, and the largest size by a capacitor motor. The lubricators are extended to the outside of the casing, and the fans are connected to the electrical supply by leads, 3ft in length, taken out through a hole in the casing which is sealed with polythene. Connectors moulded in "Neoprene" are supplied for connecting the fan to the fume cupboard and to ducting.

Indication Equipment for Remote Apparatus

A d.c. multiplexing equipment has been developed by the GENERAL ELECTRIC CO., LTD., for the continuous indication, at a central control point, of the operating state of remote apparatus. The information from up to twelve such items of equipment can be relayed to the control along a single pair of wires only, whereas previously one pair of service wires has been required for each unit to be maintained.

The equipment, which uses transistors, consists of up to twelve transmitter units and a cabinet containing the corresponding receiver sub-unit. Each transmitter unit is enclosed in an hermetically sealed can and connections are made to a terminal block. A case can be provided at the side to house a supply battery. On continuous load the battery will operate for approximately six months before replacement becomes necessary. If it is undesirable to use a battery, the transmitter will operate from a d.c. supply of 50 V.

The receiver cabinet will house twelve working receiver sub-units and twelve spare sub-units or, alternatively, twenty-four working receiver units for operation on two pairs of wires giving a service to a maximum of twenty-four monitoring points. The band-pass filter and relay are in separate hermetically sealed cans, and the detector and amplifier are cast in epoxy resin.

The equipment, which will operate over a wide range of temperatures and humidity, can be used to relay signals along wires up to five miles long.

Convector Heater

A newly designed thermostatically controlled 2 kW convector heater is being produced by REEVES ELECTRICAL & RADIO CO., LTD., Reelek Works, Baldock, Herts. Small and compact, it has an attractive appearance and is easily portable. The overall measurements are 20in high by 22in long by 10in wide. It is made of a heavy gauge steel and by removing a full length panel at the back of the casing complete access is available to the elements, lamp, thermostat and wiring connections.

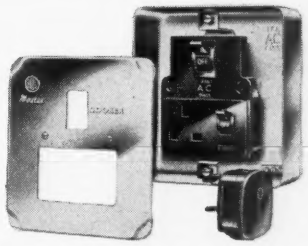
The heater has a mottled fawn stove enamelled finish with aluminium front gauze with plated trimmings. The handle and thermostat knob are of plastic. The convector costs £5 11s plus £2 8s 8d purchase tax in the United Kingdom.

Fused Terminal Block

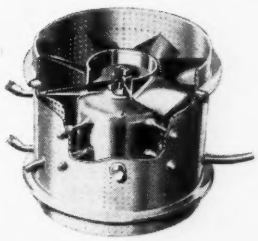
A new fused main terminal block has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, for use in fluorescent fittings. It is designed to provide sensitive fault protection, independent of circuit fuses, and will be incorporated in G.E.C. fluorescent lighting fittings in future. It is fitted with a 2 A standard miniature cartridge type fuse and is suitable for any fitting having one or more tubes of any size and a total wattage not exceeding three of 80 W rating on normal supply voltages. For larger fittings, the internal circuits are divided between two or more fused terminal blocks which may be looped on the supply side.

Since these fuses are situated at the input to the whole of the fitting, they afford protection against any earth or short-circuit fault which might arise in tubes, chokes, capacitors or in the internal wiring.

Another advantage of the fused terminal block is that the fuse is carried in a polythene moulding, which is designed with a handle for easy withdrawal and also forms a protection against accidental contact with live parts. The fuse is in the live pole of the circuit and, when it is withdrawn, the internal circuits of the fitting are all isolated from the live side of the supply, even if the external circuit has not been made dead.

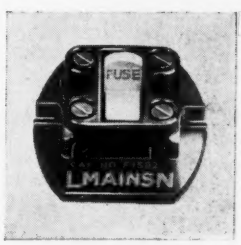


Bill "Master" cooker control unit



Woods "Aerofoil" 9½in fume cupboard fan

Reeves 2 kW convector heater



Fused mains terminal block for G.E.C. fluorescent fittings

Financial Section

STOCKS and SHARES

THE cut in the Bank Rate from 5½ to 5 per cent proved to have been correctly anticipated by the rise in the level of gilt-edged prices during the month or so preceding it. Initially, there was little further change in quotations, except among the short-dated stocks most directly affected by the event. Opinion is not yet venturing far towards predictions of the next change, but the continued firmness of the market in Government stocks shows it to be satisfied with this first easement of the dear money policy. The latter's workings have inevitably spread heavy depreciation down the list of gilt-edged securities, only a minor part of which has so far been recovered.

Industrial Market

A rise in the level of gilt-edged prices induces of course an upward adjustment in most other forms of high-grade securities, including ordinary shares of a genuine investment character. Much of the credit for the quite considerable improvement of the industrial market since the turn of the year goes consequently to the influence, or the anticipation, of the Bank Rate reduction, although other elements have no doubt played their part as an antidote to less cheerful considerations such as the fuel-oil problem and the accumulating evidence of contracting profit margins in several fields of industry. In particular, the market in electrical shares has had the benefit of atomic energy developments and has been helped in that way to give an outstandingly firm performance over the past month or two.

Price Changes

Changes among electrical share prices during the past week have been fewer, and of less consequence, than for some time past. Shares of companies in the main atomic power groups remained steady, with Associated Electrical Industries a little better, and English Electric firm, in advance of the final dividend declarations. Holophane at 23s 9d lost part of their recent big rise and there were moderate reactions also in Tube Investments, Johnson & Phillips, Plessey, Ericsson and British Tabulating. On the other hand, better prices ruled for Aron Meter, London Electric Wire, Rheostatic, Telephone Manufacturing and some others. Decca "A" shares moved up further to 32s 6d while awaiting the announcement of the results for the year ended last March.

British Electricity Stocks

This year's revival in Government securities has carried the group of British Electricity stocks some six points above the level ruling three months earlier, when the gilt-edged market was at about its lowest ebb. Between the five principal issues of the Central Electricity Authority there is a choice to suit the requirements of

Price Changes in

Company or Board	Nom. Value	Middle price 11th Feb.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	79½		3	3	3 15 6	80½	72½
Brit. Elec. 1974/77	100	76½x.d.		3	3	3 18 6	79½	71½
Brit. Elec. 1976/79	100	81½		3½	3½	4 6 0	84	74½
Brit. Elec. 1974/79	100	91½	—1	4½	4½	4 13 0	95	85½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	18/6
East African Power	£1	20/6		7	7	6 16 6	21/3	19/-
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/3		10	10*	14 0 9	17/6	14/-
Equipment and Manufacturing								
Aberdare Cables	5/-	10/6		17½	17½	8 6 9	13/6	9/9
Aerialite	1/-	6/-		45	48	8 0 0	6/9	4/9
Allen, W. H.	£1	38/3	+3d	20	10*	5 4 6	39/-	33/6
Aron Elec. Ord.	£1	55/-	+2/6	15	15	5 9 0	56/-	52/6
Assd. Automation	10/-	20/3		10	5	2 9 6	19/-	15/-
Assoc. Elec. Ord.	£1	67/6	+1/3	14	15	4 9 0	85/6	57/6
Automatic Tel. & El.	£1	57/6		15	15	5 4 3	72/6	50/-
Babcock & Wilcox	£1	80/-	+3d	15	15	3 15 0	85/6	64/-
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/9
Bakelite	10/-	21/3	—9d	16	16	7 10 6	34/-	21/3
Berry's Electric	5/-	5/9		—	10‡	8 14 0	6/6	5/9
British Aluminium	£1	65/-		12	12	3 13 9	78/9	40/6
B.I. Callender's	£1	49/3		10	12½	5 1 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3		6	6	5 13 0	22/6	20/3
British Tabulating	£1	47/-	—1/6	9	9	3 16 6	51/3	37/3
British Thermostat	5/-	26/3		20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	6/9	—6d	30	15*	11 2 3	8/9	6/-
Brook Motors	10/-	32/6		25	25	7 13 9	44/-	30/-
Brush Group	5/-	6/-		10	10	8 6 9	7/9	4/6
Bulgin, A. F.	1/-	5/3	—3d	45	50	—	5/3	4/-
Burco Dean	5/-	9/9	+6d	22½	20	10 5 0	13/6	8/3
Chloride El. Storage "A"	£1	65/9		17½	17½	5 6 6	73/6	55/-
Clarke Chapman	£1	135/-		20	22½	3 6 9	127/6	89/6
Cole, E. K.	5/-	18/9	—3d	17½	17½	4 13 3	22/3	15/-
Cossor, A. C.	5/-	6/9		15	Nil	Nil	10/3	5/-
Crabtree	10/-	25/-	+6d	20	20	8 0 0	29/3	23/-
Crompton Parkinson Ord.	5/-	16/3		16	16	4 18 6	15/-	12/3
De La Rue	5/-	18/6	—9d	30	30	8 2 3	20/3	15/-
Decca "A"	4/-	32/6	+1/9	56½	43¾*	5 7 9	44/9	23/3
Desoutter	5/-	28/-		25	30	5 7 3	32/9	25/9
Dewhurst	2/-	7/3		30	16¼*	4 9 9	7/6	5/3
Dictograph Tel.	2/-	7/3		20	20	5 10 3	7/3	5/6
Dubilier Condenser	1/-	5/9		25	30	5 4 3	5/9	3/6
Duport	5/-	19/-	—3d	23	25	6 11 6	21/6	13/9
E.M.I.	10/-	27/3	—6d	15	15	5 10 0	37/-	22/6
Electrical Components	5/-	7/3		25	25	8 12 6*	8/-	6/3
Elec. Construction	£1	25/-		8½	8½	6 16 0	29/9	22/6
Elliott Bros.	5/-	26/9	—9d	17½	20‡	3 14 9	36/9	22/6
Enfield Cable Ord.	£1	17/6	—1/3	Nil	Nil	Nil	19/3	13/-
English Electric	£1	52/6		12½	12½	4 15 3	66/3	43/9
English Electric 3¾% Pref.	£1	13/6		3¾	3¾	5 11 0	14/6	12/6
Ericsson Tel.	5/-	38/-	—1/-	20†	20†	2 12 9†	42/9	31/-
Ever Ready	5/-	30/9	—3d	35	35	5 13 9	32/9	24/-
Falk Stadelmann	£1	37/6		17½	17½	9 6 9	45/9	35/6
G.E.C. Ord.	£1	55/-		12½	14	5 1 9	65/6	41/3
G.E.C. 6½% Pref.	£1	23/-		6½	6½	5 13 0	23/9	21/3
General Cables	5/-	13/3		30	30	11 6 3	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	19/9	—6d	25	30	7 12 0	24/6	18/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	22/-	13/9
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	16/3	+3d	10½	11½	7 1 6	19/9	14/-
Holophane	5/-	23/9	—2/6	30	30	6 6 3	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡Dividend indicated.

most gilt-edged investors. For those interested primarily in current income, the 4¼ per cent British Electricity stock, redeemable between 1974 and 1979, and the 4½ per cent stock 1967/69, both give the buyer a yield a little short of 4¾ per cent on the money invested, at the respective prices of about 91½ and 96 ruling a few days after the Bank Rate change. They will also produce for the holder several points tax-free capital profit on repayment at 100 within the fixed dates. Taking this into account, the "redemption yields" work out at nearer 5 per cent.

In the case of the two 3 per cent British Electricity stocks, both of which can still be bought below 80, the main attraction remains the assurance of capital profits of over 20 points (equal to 25 per cent on the amount of money invested) upon their eventual repayment at 100. Repayment of the senior stock (the one issued originally at 100 by way of compensation for shareholdings in the nationalised electricity supply companies) must occur between 1968 and 1973; for the other 3 per cent stock the redemption period is 1974/77. Current yields in these two cases are of course relatively small, at not much over 3¾ per cent; but the return is improved by more than 1 per cent in the "redemption yields," which take additionally into account, on an annual basis, the benefit of the capital profits due to accrue over the remaining life of the stocks. Since the latter element in the return is free of tax, these 3 per cent stocks make their principal appeal to people in the high income-tax brackets.

Electrical Investments

Company or Board	Nom. Value	Middle price 11th Feb.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	28/9	—6d	70	50	8 14 0	39/3	23/-
I.C.I.	£1	42/3	+3d	10	10	4 14 9	49/9	37/3
Intl. Combustion	5/-	22/9	+6d	25	20*	4 8 0	25/-	15/3
Johnson & Phillips	£1	30/-	—2/-	15	15	10 0 0	46/6	27/6
Lancashire Dynamo	£1	43/9		15	11*	5 0 6	49/9	37/6
Laurence, Scott	5/-	16/9	+6d	12½	15	4 9 6	16/9	13/3
Lister, R. A.	£1	30/-		9·3	10	6 13 3	35/3	24/6
London Elec. Wire	£1	47/6	+9d	12½	12½	5 5 3	52/9	42/6
Lucas, J.	£1	32/6		7½	7½	4 12 3	40/3	28/9
Marryat & Scott	2/-	8/3		30	30	7 5 6	11/3	8/9
Mather & Platt	£1	54/6	—6d	15	15	5 10 0	65/3	50/-
Metal Industries	£1	24/6		9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	46/3		10	12½	5 8 0	48/6	43/6
Morphy-Richards	4/-	12/-		50	50	—	13/9	10/-
Murex	£1	69/6	—1/3	20	20	5 15 3	74/6	60/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	7/6		14	12	8 0 0	9/6	5/6
Parsons, C. A.	£1	56/3		10	10	—	—	—
Plessey	10/-	69/6	—1/-	27½	30	4 6 3	87/6	56/-
Pye "A" Deferred	5/-	16/3		12½	12½	3 17 0	21/3	13/3
Reyrolle	£1	97/6		15	16½	3 6 9	117/6	81/-
Rheostatic	4/-	10/-	+1/-	18½	12‡	4 16 0	—	8/3
Richardsons Westgarth	5/-	18/-		16⅝	16⅝	4 12 6	17/3	13/9
Scottish Cables	4/-	18/3		27½	27½	6 0 6	17/9	14/9
Smith (England), S.	4/-	13/9	—3d	17½	17½	5 1 9	14/3	10/6
Southern Areas	£1	17/6		10	7½	8 11 6	28/9	13/9
Strand Elec.	5/-	7/9	—6d	15	15	9 13 6	8/6	6/9
Sturtevant	5/-	25/-		14·4†	15†	3 0 0†	31/3	21/3
Sun Elec.	£1	43/9		20	25	11 8 6	42/6	33/9
Switchgear & Cowans	5/-	15/3		20	25	8 4 0	17/-	12/9
Taylor Tunnicliff	5/-	13/3		15	15	5 13 3	14/-	11/3
T.C.C.	10/-	37/6		25	25	6 13 3	45/-	33/9
T.C. & M.	£1	29/6		8½	8½	5 15 3	34/-	24/-
Telephone Mfg.	5/-	6/9	+3d	10	10*	7 8 3	8/6	6/-
Thorn Elec.	5/-	18/9		15	15	4 0 0	22/6	15/-
Thornycroft	£1	33/9		15	12½	7 8 3	49/9	33/6
Tube Investments	£1	60/-	—1/3	22½	15*‡	5 0 0	70/6	50/9
Vactric	5/-	15/-		15	17½*	5 16 9	15/-	11/-
Veritys	5/-	9/3		12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	12/3		70	20*	6 10 6	13/6	10/9
Ward & Goldstone	5/-	40/-		30	35	4 7 6	39/6	29/-
Watford	2/-	6/6		25	25	7 13 9	7/6	5/6
Westinghouse	£1	77/6	—2/6	18	18	4 12 9	100/-	67/6
West, Allen	5/-	14/-		15	15	5 7 3	14/6	11/3
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	23/3		8	8	6 17 9	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	19/6	—6d	22½	22½	5 15 6	20/-	15/6
Cable & Wireless: Ord.	5/-	11/3		10	10	4 9 0	11/3	9/3
4% Loan	100	91		4	4	4 8 0	92½	88
Calcutta Trams	£1	25/9		7½†	8½†	6 12 0†	27/6	23/-
Cape Elec. Trams	£1	15/6	+6d	8	8	10 6 6	20/3	15/6
Marconi Marine	£1	33/-		10	10	6 1 3	34/-	31/-
Oriental Tel. Ord.	1/-	72/6		16	—	—	90/-	66/3
Telephone Rentals	5/-	10/9		12½	12½	5 16 3	11/9	9/6

Hoover

Hoover ordinary shares, although a little below their recent best, have shed some of last year's depression. There was a warning of difficult trading conditions at the time of the 1956 interim dividend declaration, when this payment was maintained at the previous rate of 10 per cent. In the first six months of the year turnover at home had been reduced by 29 per cent as a result of Government restrictions affecting sales, and the net group profit (before tax) was estimated to have come down in the period from about £2¼ million to little more than £1 million. Prospects for the second half were said not to indicate any appreciable improvement. The 5s ordinary shares fell to 23s 6d and remained there until a few weeks ago, when they began to recover, apparently on tentative hopes of a coming easement of the hire-purchase regulations. They stand now at 28s 9d.

Market Notes

Dealings were expected to begin to-day (Friday) in a new issue of the Northern Ireland Electricity Board. This 5 per cent stock, redeemable between 1975 and 1977, was offered for public subscription at a price of 98½. Guaranteed by the Government of Northern Ireland, it ranks as a trustee stock. In the industrial market, Enfield Cables ordinary receded a little to 17s 6d, but remained several shillings above the price ruling before the start of rumours about an offer for the shares, concerning which the directors of the company have denied knowledge. Metal Industries shares were maintained at 24s 6d after their re-entry into the dividend list with an interim payment of 3 per cent on account of the year ending next month.

REPORTS and DIVIDENDS

Electricity Board for Northern Ireland.—The prospectus was published on Monday last, and the lists opened and closed on Wednesday, of an issue of £3 million 5 per cent guaranteed stock, 1975-77, at a price of £98 10s per cent. Redemption is at par on 1st August, 1977, but the Board has the option to redeem all or part, also at par, on or after 1st August, 1975. The proceeds of the issue will be used for the repayment of short-term temporary borrowings and to meet further expenditure on the development in Northern Ireland of electricity generation and distribution. It is stated that sales of electricity by the Board have risen in the past eleven years from 111·1 million kWh in 1946 to 465·4 million kWh last year.

Peto Scott Electrical Instruments, Ltd.—The directors of the Peña Copper Mines, Ltd., have issued a statement to the effect that arrangements having been made under which the company will acquire a substantial minority interest in Peto Scott Electrical Instruments, Ltd., Major-General E. L. Bols, chairman, and Mr. C. W. A. Artis, one of the directors, have joined the board of Peto Scott. Peña Copper Mines states that its acquisition is in the nature of an investment, with a view, in addition, to the establishment of co-operation between its own electronics interests and those of Peto Scott. The acquisition does not at this stage presage any offer to Peto Scott shareholders to acquire the balance of the issued share capital.

Metal Industries, Ltd.—In accordance with the indication given at the annual general meeting last October, the company has resumed payment of dividends on the ordinary stock with an interim dividend of 3 per cent.

J. & E. Hall, Ltd.—The accounts for the year to 30th September last show a trading profit of £538,468, as compared with £476,901 for 1954-55, and after meeting all charges, including £295,000 for taxation, the net profit is £267,858 (against £234,836). It is proposed to pay a final ordinary dividend of 10 per cent, maintaining the distribution for the year at 12½ per cent, and to carry forward £896,794 (against £705,526 brought in).

Electrical Components, Ltd., has declared an interim ordinary dividend of 5 per cent (against 10 per cent) on doubled capital.

New Companies

Burra Engineering (Electrical), Ltd.—Registered 18th January. Capital £5,000. Directors: Frank E. Goddard and Frederick E. Goddard. Regd. office: 15, Buckingham Palace Gardens, London, S.W.1.

Henry Hall (Gateshead), Ltd.—Registered 30th January. Capital £11,000. Electrical, mechanical, marine, constructional, internal combustion and general engineers, etc. Regd. office: Brandling Street, Gateshead.

Telerelays, Ltd.—Registered 24th January. Capital £100. Telephonic and telegraphic service company and engineers, etc. Directors: E. G. Briers and B. R. Marraner. Solicitors: Hamilton Hill & Partners, N.13.

D. R. P., Ltd.—Registered 24th January. Capital £100. Manufacturers, dealers in, buyers, hirers out, etc., of appliances used for the purpose of or in connection with telephones, telegraphs, etc. Solicitors: Bulcraig & Davis, Amberley House, Norfolk Street, W.C.2.

Ashmor Distributors, Ltd.—Registered 24th January. Capital £100. Manufacturers of and dealers in domestic, household and general electrical and other equipment and appliances, etc. Directors: R. J. B. Morgan and L. F. Washington. Regd. office: 3, Cromwell Road, S.W.7.

Birlite Batteries, Ltd.—Registered 23rd January. Capital £100. Designers, manufacturers of and dealers in accumulators and other electrical storage batteries, etc. Solicitors: Linklaters & Paines, 59-67, Gresham Street, E.C.2.

W. G. Grover, Ltd.—Registered 29th January. Capital £100. Manufacturers of and dealers in electrical apparatus and equipment of all kinds, etc. Directors: W. G. Grover and Mrs. Sarah L. Grover. Regd. office: 152, Hoe Street, Walthamstow, E.17.

Stanwall Electric, Ltd.—Registered 29th January. Capital £100. Electrical equipment specialists, manufacturers of and dealers in batteries, accumulators, magnetos, dynamos, plugs, transformers, electric motors, etc. Directors: W. D. Gibbs, K. P. Robertson, L. W. E. Gibbs and S. J. Gibbs. Regd. office: 16, Windmill Road, W.4.

Keep Electrical Co., Ltd.—Registered 29th January. Capital £2,000. Designers, manufacturers of and dealers in electrical, electronic, radio, television and telephone apparatus, etc. Directors: C. J. Keep, Mrs. Mabel Keep and G. R. Keep. Regd. office: 9, Campo Lane, Sheffield, 1.

Grahams Electrical (Caledonian Road), Ltd.—Registered 28th January. Capital £100. Wholesale and retail merchants, manufacturers, importers, exporters and agents of all kinds of apparatus used for lighting, heating, freezing, etc. Directors: L. Graham, Lily Graham and J. A. Graham. Regd. office: 92, Portland Place, W.1.

F. W. Spencer & Son, Ltd.—Registered 29th January. Capital £500. To acquire the business of electrical engineers and contractors carried on by Fredk. W. Spencer at South Harrow as F. W. Spencer and Son. Directors: F. W. Spencer and Mrs. Hilda J. Spencer. Regd. office: 114, Walton Avenue, South Harrow, Mdx.

Grangemouth Electrical Services, Ltd.—Registered in Edinburgh 19th December. Capital £5,000. Engineers, electrical engineers and contractors, etc. Directors: W. Kemp and F. Cooper. Regd. office: 68-70, Lumley Street, Grangemouth.

Increases of Capital

Wild-Barfield Electric Furnaces, Ltd.—Increased by £28,000 in 3,000 6 per cent first preference and 25,000 ordinary shares of £1, beyond the registered capital of £44,500.

Morphy-Richards, Ltd. — Increased by £570,000 in 2,850,000 ordinary shares of 4s, beyond the registered capital of £430,000.

Elliott Brothers (London), Ltd.—Increased by £500,000 in 5s ordinary shares, beyond the registered capital of £1,500,000.

Liquidation

M. S. Webb & Sons, Ltd., electrical engineers and contractors.—Liquidator, Mr. G. F. Morris, Inveresk House, 346, Strand, London, W.C.2, released 11th January.

Bankruptcies

W. J. Ward, 29, Stanesfield Road, Cambridge, formerly carrying on business at 67, Norfolk Street, Cambridge, under the style of Walter Ward, as an electrical contractor and engineer.—Public examination 10th April, at the Guildhall, Cambridge.

G. W. Altass, 1, Bruce Avenue, Shepperton, Middx, electrical engineer and general contractor.—Last day for receiving proofs for dividend to-day (15th February). Trustee, Mr. J. W. Skelsey, 2-3, Norfolk Street, W.C.2.

T. E. Boothby, G63, Du Cane Court, Balham, London, S.W.17, electrical engineering consultant.—Trustee, Mr. T. J. M. Macleod, 4, Bucklersbury, London, E.C.4, appointed 1st February.

G. S. Lacey, 74, St. Giles Street, Norwich, electrical engineer.—First and final dividend of 4s 9d in the £, payable at the Official Receiver's office, Castle Chambers, Opie Street, Norwich.

F. Kent, 397, High Street, Lincoln, trading as Lincoln Factoring Co., electrical wholesaler.—Last day for receiving proofs for dividend 19th February. Trustee, Mr. E. C. Simpson, 27, Regent Street, Park Row, Nottingham.

Street Lighting Plans

Billingham (Co. Durham) U.D.C. has approved the provision of Class "A" lighting in road A19 at a cost of £2,375.

Tenders are to be considered by the **Thornaby-on-Tees** Town Council for the supply of equipment in connection with a £3,200 scheme for the lighting of Thornaby Road with mercury discharge vapour lamps.

Approval has been obtained to the £3,340 scheme of **Brimington** (Derbyshire) Parish Council for the installation of sodium lighting along the A619 road through the parish.

The Ministry of Housing and Local Government has approved the **Washington (Co. Durham)** Council's estimate at £1,176 for electric street lighting at the Coach Road estate.

Burton-on-Trent Public Works Committee has approved a recommendation of the borough surveyor that the work needed to complete the conversion of the whole town to modern electric street lighting should be carried out during 1957-58.

The first street lighting installation in Britain to use the new "Osram" integral sodium lamp is now in operation in **St. Pancras, London.** By replacing the mercury vapour lanterns with sodium lanterns mounted on the existing columns the Council estimates that it will save about £4,000 annually in electricity charges, while maintaining the same illumination intensity.

Scunthorpe Town Council is to spend £40,600 on the lighting of streets on the new Riddings estate.

Rochdale Corporation is recommended to make application for sanction to borrow £5,590 for sodium lighting in various roads.

Huyton-with-Roby Works Committee has approved in principle a scheme, estimated to cost £9,310, for improved lighting in Liverpool Road.

Ilford Corporation reports that the borough engineer has in hand the preparation of a scheme, estimated to cost £20,000, for the lighting of various unclassified roads.

As part of a four-year programme costing £11,000, **Watford** Highways Committee proposes to improve the lighting of Whippendell Road, Cassie Road, Clarendon Road, Station Road, Woodford Road and part of Queen's Road in 1957-58.

Dundee Corporation has approved a scheme, estimated to cost £2,691, for street lighting on the fourth development of the Mid Craigie housing estate.

West Hartlepool Town Council is recommended to spend £1,275 on improvements to street lighting in Hart Road and £1,660 on similar work in Raby Road, West Hartlepool.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 18th February

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "Electric Floor Warming and Storage Heating," by J. S. A. Primrose.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Supply Group. "Preventive Maintenance," by P. L. Lutte and A. G. Milne.

CARLISLE. — Technical College, 7 p.m. I.E.E. North-Eastern Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. "Digital Computers," by Dr. J. L. Miller.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Power System Protection, with Particular Reference to the Application of Junction Transistors to Distance Relays," and "A Dual-Comparator Mho-Type Distance Relay Utilising Transistors," by C. Adamson and L. M. Wedepohl.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers, informal meeting. Discussion on "The Impact of Radioactive Isotopes on the Utilisation Field," opened by Dr. D. Taylor.

Dorchester Hotel, W.1, 7 for 7.30 p.m. Association of Consulting Engineers. Annual dinner.

John Adam Street, Adelphi, 6 p.m. Royal Society of Arts. Cantor Lecture, "Modern Lighting," by D. W. Durrant, C. Dykes Brown and J. M. Waldram.

MANCHESTER.—College of Science & Technology, 7.15 p.m. Institution of Production Engineers, Manchester Section. Symposium on "Application of the Computer in Management Control," by E. S. Carden.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. Informal lecture on "The Use of Transistors in Radio and Television," by Dr. A. J. Biggs.

Tuesday, 19th February

BIRMINGHAM.—At the Midlands Institute, Paradise Street, 5.30 p.m. "Some Aspects of Atomic Energy," by C. M. Nicholls. (Joint meeting of the Institution of Chemical Engineers, Midlands Branch, and the Society of Chemical Industry, Birmingham Group.)

CAMBRIDGE.—Cavendish Laboratory, Free School Lane, 8 p.m. I.E.E. Cambridge Radio & Telecommunication Group. Informal evening on "Electronics and Automation"; talk by Dr. H. A. Thomas.

CHELTENHAM.—Fleece Hotel, High Street, 6.30 p.m. I.E.S. Gloucester & Cheltenham Centre. Architects' night.

COVENTRY.—Electricity Sports & Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. "High Fidelity Sound Equipment," by R. Hawes.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "Visit to Russia," by J. S. Pickles and R. J. Rennie.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilisation Group. "A Self-Oscillating Induction Motor for Shuttle Propulsion," by E. R. Laithwaite and P. J. Lawrenson, and "Brushless Variable-Speed Induction Motors," by Prof. F. C. Williams, E. R. Laithwaite and L. S. Piggott.

LONDON.—2, Savoy Hill, W.C.2, 6.30 p.m. Association of Supervising Electrical Engineers. "Nuclear Generation," by P. J. Squire.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurement & Control Group. "Ship Stabilisation: Automatic Controls, Computed and in Practice," by J. Bell.

NOTTINGHAM.—College of Arts and Crafts, Waverley Street, 6.30 p.m. I.E.E. East Midland Centre. "Testing of Boilers and Turbo-Alternators in Power Stations of C.E.A.," by H. S. Horsman. (Joint meeting with the East Midlands Branch of the Institution of Mechanical Engineers.)

RUGBY.—College of Technology and Arts, 6.30 p.m. I.E.E. Rugby Graduate and Student Section. "Quality Control," by N. R. Bedford.

WORKINGTON.—College of Further Education, 7 p.m. I.E.E. North-Eastern Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

Tuesday, 19th February, to Thursday, 21st February

LONDON.—Central Hall, Westminster, 7.30 p.m. Institution of Mechanical Engineers. Conference on "The Mechanical Engineer's Contribution to Clean Air."

Tuesday, 19th February, to Friday, 22nd February

MANCHESTER. — N.W.E.B. Demonstration Theatre, Town Hall. I.E.S. Manchester Centre. Conference and exhibition on "Light and Colour in the Home."

Wednesday, 20th February

BIRMINGHAM. — College of Technology, Gosta Green, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. Discussion on "Engineering Education in Europe," opened by R. G. Bellamy, J. Ashmore and C. F. Partridge.

BURTON-ON-TRENT. — Electricity Service Centre, 6.30 p.m. I.E.E. North Staffordshire Sub-Centre, district meeting. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

CARDIFF.—College of Technology, Cathays Park, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Radioactivity and its Measurement," by E. W. Pulsford.

FARNBOROUGH.—R.A.E. Technical College, 7.30 p.m. I.E.E. Southern Centre. "The Control of Nuclear Reactors," by R. J. Cox and J. Walker.

LEICESTER.—Grand Hotel. Incorporated Plant Engineers, Leicester Branch. Annual dinner and dance.

LONDON.—Northampton Polytechnic, St. John Street, E.C.1, 5.30 p.m. I.E.E. Radio & Telecommunication Section. "The Stereosonic Recording and Reproducing System (a Two-Channel System for Domestic Tape Records)," by H. A. M. Clark, Dr. G. F. Dutton and P. B. Vanderlyn.

Waterloo Bridge House, S.E.1, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. Informal meeting. "Electronic Circuitry—Are Diagrams Really Essential?" by J. A. Lawrence, G. S. Gregson and F. L. N. Samuels.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institution, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "Shop Window and Store Lighting," by R. L. C. Tate.

NOTTINGHAM. — E.M.E.B. Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. "Reeent Developments in Winding Wires," by C. P. Fox, with film.

PRESTON.—19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "Colour Matching," by A. Wilcock.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

Royal Victoria Station Hotel. Institution of Heating & Ventilating Engineers, Yorkshire Branch. "Heating by Electricity, some Design Data," by G. A. Farthing.

WOLVERHAMPTON. — Technical College, Wulfruna Street, 7.30 p.m. Institution of Production Engineers, Wolverhampton Graduate Section. "The Field of Application of Automatic Arc Welding," by J. A. Lucey.

Thursday, 21st February

CHELMSFORD. — Crompton's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "Electronic Control—New Power in Industry and the First Automatic Factory," by J. A. Sargrove.

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

EXETER.—Electricity Showrooms, Bedford Street, 3 p.m. I.E.E. South-Western Sub-Centre. "Nuclear Energy and Electricity Generation," by G. T. Shepherd.

GLASGOW.—Rhul Restaurant, Sauchiehall Street, 7.30 p.m. I.E.S. Glasgow Centre. Buffet-dance.

LONDON.—At the Royal Institution, Albemarle Street, W.1, 5.30 p.m. Institution of Chemical Engineers and British Nuclear Energy Conference. "The Processing of Nuclear Reactor Fuels," by R. Spence and C. M. Nicholls.

Caxton Hall, S.W.1, 2.30 p.m. Diesel Engineers' & Users' Association. "Pressure Charging of Small C.I. Engines," by N. Anderson.

NEW BRIGHTON.—Hotel Victoria. Incorporated Plant Engineers, Merseyside & North Wales Branch. Dinner and dance.

SITTINGBOURNE.—Coniston Hotel, 8 p.m. A.S.E.E. Kent Branch. "Electrical Safety," by S. J. Emerson.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Fluorescent Lamp Maintenance and Fault Finding," by W. A. R. Stoyle.

STOCKPORT.—Alma Lodge Hotel, Hazel Grove, 7 p.m. Electrical Trades' Commercial Travellers' Association, North Western Branch. Ladies' evening.

Friday, 22nd February

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. Annual general meeting.

COVENTRY.—Leofric Hotel. Incorporated Plant Engineers, Birmingham Branch. "Electronics in Industry."

EDINBURGH.—The University, 7 p.m. British Institution of Radio Engineers, Scottish Section. "The Field Evaluation Trials of Electronic Equipment," by H. Holmes, and "The Electronic Manipulation of Digits Applied to Statistics," by J. Kyles. (Joint meeting with the Royal Statistical Society.)

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduate & Student Section. Conversazione and dance.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Photography in Engineering," by Dr. L. Mullins.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North Eastern Graduate & Student Section. Students' Lecture, "Man/Machine Relationships," by W. H. Dunkley.

County Hotel. Institution of Heating & Ventilating Engineers, North East Coast Branch. Annual dinner and dance.

WIMBLEDON.—Prince of Wales Hotel, Hartfield Road, S.W.19. A.S.E.E. South West London Branch. Annual dinner.

Saturday, 23rd February

BIRMINGHAM.—Midland Hotel. Institution of Works Managers, Birmingham Branch. Ladies' night—dinner-dance.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 20th February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1953

3036. General Electric Co.—Regulating systems for synchronous electric generators. 3rd February, 1953. (768445.)

24000. Electric & Musical Industries, Ltd. —Synchronising circuits. 31st August, 1954. (768678.)

26693. Ericsson Telephones, Ltd., and Burnett, L. C.—Electronic counting circuits. 29th December, 1954. (768550.)

29267. Payne, E. L.—Measurement of the modulation ratio of an amplitude modulated high frequency signal. 25th October, 1954. (768679.)

32884. Communications Patents, Ltd.— Wired broadcasting of colour television. 25th February, 1955. (768682.)

33772. General Electric Co., Ltd., and Beesley, J. H.—Electric circuit arrangements for supplying trains of electric pulses. 24th November, 1954. (768683.)

1954

795. Compagnie Générale de Télégraphie sans Fil.—Ceramic pieces of high dielectric constant and process of their manufacture. 11th January, 1954. (768555.)

1021. General Electric Co., Ltd., and Stenning, L. C.—Electro pulse selecting circuits. 9th February, 1955. (768688.)

2734. International Business Machines Corporation.—Impulse emitting devices. 29th January, 1954. (768556.)

3461. General Electric Co., Ltd.—Electrical gas discharge tube circuits. 31st January, 1955. (768653.)

6367. Ultra Electric, Ltd.—Television receivers. 22nd February, 1955. (768561.)

7480. Alpha Accessories, Ltd.—Electrical primary batteries. 11th March, 1955. (768449.)

8053. Ellenburger & Poenscen Ges.— Device for producing periodical changes in an electric circuit. 19th March, 1954. (768692.)

8790. M-O Valve Co., Ltd., Robertshaw, R. G., and Willshaw, W. E.—Travelling-wave magnetron oscillators. 23rd March, 1955. (768563.)

9769. Midgley, A. H.—Time delay mechanisms for electric switches. 18th February, 1955. (768842.)

9976. Reyrolle & Co., Ltd., A.—Electric switchgear. 1st July, 1955. (768693.)

10507. Western Electric Co., Inc.—Magnetrons. 9th April, 1954. (768564.)

13651. Siemens & Halske Akt.-Ges.— Process for producing electrical condenser foils. 11th May, 1954. (Addition to 677489.) (768700.) 15643. Process for the manufacture of electrical condensers. 27th May, 1954. (768702.)

17517. Anderson, Boyes & Co., Ltd.— Protective systems for polyphase a.c. loads. 15th June, 1955. (768703.)

18282. Philips Electrical Industries, Ltd. —Apparatus for selecting stabilised frequencies for controlling an oscillator. 22nd June, 1954. (768572.)

18628. Cole, Ltd., E. K., and King, A. E. —Printed circuits. 27th June, 1955. (Cognate application 29843, 16th October, 1954.) (768706.)

21214. Brown, L.—Electrically heated radiators. 15th August, 1955. (768710.)

23554. Krizik Karlin, Vyoojovy, Zavod, Narodni Podnik.—Circuit arrangement for cathode follower and similar circuits. 13th August, 1954. (768460.)

24505. Buisson, P.—Electronic comparators. 23rd August, 1954. (768723.)

25816. West Lancashire Radio & Television Laboratories, Ltd., Vicars, Ltd., T. & T., and Radio Heaters, Ltd.—Ovens for dielectric heating. 16th August, 1955. (768725.)

25947. Adcola Products, Ltd.—Electrical soldering irons. 2nd September, 1955. (768461.)

26255. Wilmot-Breeden, Ltd.—Electric lighting fittings. 5th September, 1955. (768726.)

26592. Ammon, R. A.—Moving coil electrical instrument. 14th September, 1954. (768578.)

26862. Licentia Patent-Verwaltungs Ges. —Method for the manufacture of electric asymmetrically conducting systems. 16th September, 1954. (768462.)

29773. General Electric Co.—Junction type semi-conductor electrical devices. 15th October, 1954. (768731.)

30136. Lukacs, F. B.—Tools for stripping electric cables. 19th October, 1955. (768853.)

31417. Automatic Telephone & Electric Co., Ltd.—Magneto bells. 25th August, 1955. (768736.)

34223. British Thomson-Houston Co., Ltd.—Erection of engine-generator sets. 25th November, 1955. (768858.)

35679. Philips Electrical Industries, Ltd. —Devices for reproducing coloured television images. 9th December, 1954. (768747.)

36793. Canadian General Electric Co., Ltd.—Electrical circuits for measuring power in an a.c. load. 20th December, 1954. (768749.)

36913. English Electric Co., Ltd.— Electro-hydraulic devices. 21st December, 1955. (768861.)

1955

109. Cooper & de Beer (Proprietary), Ltd., and Beer, C. L. de.—Single-phase circuit-breakers. 3rd January, 1955. (768750.)

2299. Atlas Powder Co.—Bonding high resistance wires to copper or copper alloys. 26th January, 1955. (768751.)

3043. Distillers Co., Ltd.—Method for the discharge of electricity from liquids. 18th January, 1956. (768752.)

4477. Standard Telephones & Cables, Ltd. (International Telephone & Telegraph Corporation).—Diversity reception system. 15th February, 1955. (768469.)

5612. Hoover, Ltd.—Food mixers. 24th February, 1955. (768872.)

6011. Institut de Recherches de la Sidérurgie.—Voltage measuring instrument providing readings with an adjustable magnification range. 1st March, 1955. (768475.)

7944. Standard Telephones & Cables, Ltd.—Stranded conductors for electric cables. 18th March, 1955. (768477.)

9511. Akt.-Ges. Brown, Boveri & Cie.— Single column isolating switch. 1st April, 1955. (768479.)

9630. Siemens & Halske Akt.-Ges.—Temperature-sensitive resistance elements. 1st April, 1955. (768481.)

9748. General Motors Corporation.— Apparatus for electrically detecting and indicating the degree of smoothness of a surface. 4th April, 1955. (Addition to 699728.) (768487.)

9922. Philips Electrical Industries, Ltd.— Synchronous motors comprising an armature having permanent magnetic poles. 5th April, 1955. (768885.)

10119. General Electric Co.—Exhausting and sealing equipment for glass envelopes. 6th April, 1955. (768495.)

10196. Westinghouse Electric International Co.—Electric fans. 7th April, 1955. (768898.)

10314/5. British Thomson-Houston Co., Ltd.—Lampholders for double-ended electric lamps. 7th April, 1955. (768500/1.)

10444. Rowenta Metallwarenfabrik Ges. —Electric iron. 12th April, 1955. (768505.)

10630. Hazeltine Corporation.—Signal separating circuit for a colour television receiver. 13th April, 1955. (768508.)

10946. Sangamo Weston, Ltd.—Maximum demand meters. 15th April, 1955. (768609.)

11140. General Electric Co.—Cooling system for induction apparatus. 18th April, 1955. (768517.)

11253. Allied Control Co., Inc.—Counter-balanced armature for electromagnets. 19th April, 1955. (768618.)

11266. Philips Electrical Industries, Ltd. —Magnet systems. 19th April, 1955. (768518.)

11280. Westinghouse Electric International Co.—Fluid-blast circuit interrupters. 19th April, 1955. (768911.)

11318. Sylvania Electric Products, Inc.— Planar type electron tubes. 19th April, 1955. (768786.)

11586. Naamlooze Vennootschap Coq.— Contact arrangements of electric switches. 21st April, 1955. (768797.)

11700. Standard Telephones & Cables, Ltd.—Image reproducing device. 22nd April, 1955. (768800.)

11870. Philips Electrical Industries, Ltd. —Lighting fittings. 25th April, 1955. (768627.)

11927. Mycalex Electronics Corporation. —Manufacture of insulated terminal structures for electrical apparatus. 25th April, 1955. (768805.)

11998. Sylvania Electric Products, Inc.— Nickel alloy cathodes for electron-discharge devices. 26th April, 1955. (768916.)

12033. Skillman & Co., Pty., Ltd., T. S. —Signalling in telephone systems. 26th April, 1955. (768917.)

12138. Soc. Triflux.—Glow discharge tubes. 27th April, 1955. (768535.)

12289. Mullard Radio Valve Co., Ltd.— Radio frequency circuit arrangements. 28th April, 1955. (768539.)

12517. Siemens & Halske Akt.-Ges.— High frequency multi-layer transmission lines. 29th April, 1955. (768828.)

13087. General Electric Co.—Electric contact making brushes such as employed for dynamo-electric machines. 5th May, 1955. (768928.)

13175. General Motors Corporation.— Electric pedal-operated switches. 6th May, 1955. (768929.)

13536. British Thomson-Houston Co., Ltd. — Commutating dynamo - electric machines. 10th May, 1955. (768931.)

14833. General Electric Co.—Electromagnetic control devices. 23rd May, 1955. (768937.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 6th March:—

No. 747,594 (design). Class 7. Turbine rotor and stator blades. — Hepworth & Grandage, Ltd., St. John's Works, Bradford, 4.

JAMBOREE. No. 758,503. Class 9. Radio receivers and record players.—Vidor, Ltd., 681, Salisbury House, Finsbury Circus; and London Wall, London, E.C.2.

T R. No. 748,145. Class 9. Internal telephone installations; sound reproducing apparatus; measuring, signalling, warning and recording instruments; radio receiving apparatus; and parts.—Telephone Rentals, Ltd., also trading as Operating TR Services, Kent House, Rutland Gardens, Knightsbridge, London, S.W.7.

MINI POL. No. 758,662. Class 9. Electric suction cleaners and domestic electric floor polishing machines and parts.—Vacuum Cleaner Supplies, Ltd., 20-22, Gipsy Hill, London, S.E.19.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—Brisbane City Council. 12th April. Twelve 1,000 MVA outdoor type oil circuit-breakers. (E.S.B. 2749/57. Ten/23998.)*

Braintree. — R.D.C. Applications are invited by 21st February from firms who wish to be included on the Council's list of selected tenderers for the supply of electrical fittings, including cookers, coppers, etc. Forms from the clerk, St. Peter's Close, Bocking, Braintree, Essex.

Brighouse.—Borough Council. 8th March. Street lighting equipment. (See this issue.)

Bury.—Borough Council. 5th March. Street lighting equipment. (See this issue.)

Ceylon.—Ministry of Transport and Works. 29th May. Diesel-hydraulic or diesel-electric power coaches and control equipment for four-coach train units. (E.S.B. 3417/57. I.C.A. Ten/24077.)*

Dore and Bredwardine.—R.D.C. 11th March. Electrically driven duplicate booster pumps, and auxiliary equipment, for the area water supply scheme. John H. Haiste & Partners, engineers, Suite 2, 8-10, Southgate Street, Gloucester.

East Riding.—County Council. 27th February. Electric lamps for the year ending 31st March, 1958. Supplies officer, County Hall, Beverley.

Eston.—U.D.C. 25th February. Street lighting equipment. (See this issue.)

Formosa.—Central Trust of China, Purchasing Department. 25th February. 100 kVA diesel generating set. (E.S.B. 3338/57. I.C.A. Ten/24038.)* Radio components, including valves, transformers, resistors, capacitors, etc. (E.S.B. 3337/57.I.C.A. Ten/24037.)* 4th March. Four 3·45 kV control panels. (E.S.B. 3332/57.I.C.A. Ten/24044.)* 12th March. X-ray units. (E.S.B. 3450/57. I.C.A. Ten 24058.)*

India.—Bombay Electricity Board. 3rd May. Steel towers, insulators and conductors. (E.S.B. 3188/57. Ten/24010.)*

Director General of Supplies and Disposals. 5th March. Paper insulated lead alloy cable. (E.S.B. 2964 57. Ten/23995.)* 8th March. 4 kV and 11 kV switchgear for Satna thermal power station. (E.S.B. 3392/57. Ten/24067.)*

Mauritius.—Central Electricity Board. 15th March. 500/1,000/1,200 kW, 6·6 kV water-turbine driven generator sets with alternators and switchgear. (See this issue.)

Mildenhall.—R.D.C. 25th February. Electrically driven submersible pump for Brandon waterworks. Silcock and Simpson, engineers, 10, Park Row, Leeds, 1.

New Zealand.—Auckland Electric Power Board. 26th April. 11 kV switchgear and associated equipment. (E.S.B. 3154/57. Ten/24023.)*

Rhodesia and Nyasaland.—Federal Tender Board. 22nd February. 30 diesel or petrol engine generator power plants. (E.S.B. 3259/57. Ten/24031.)* 1st March. 1,000 cable terminal boxes. (E.S.B. 3260/57. Ten/24074.)*

Rhodesia Railways. 26th March. Electric arc furnace. (E.S.B. 3021/57. Ten/23996.)*

Rowley Regis.—Borough Council. 22nd February. Electricians' requisites for the year ending 31st March, 1958. John Hilton, town clerk, Municipal Buildings, Old Hill, Staffs.

South Africa.—Stores Department, South African Railways. 6th March. Electric cable. (E.S.B. 3205/57. Ten/24057.)* Thirteen 5 kVA transformers. (E.S.B. 3206/57. Ten/24048.)* 15th March. Six switchboards. (E.S.B. 3207/57. Ten/24040.)*

Southend-on-Sea.—Borough Council. 1st March. Electrical installations in Leigh and Southchurch libraries. (See this issue.)

Stanley.—U.D.C. 4th March. Street lighting equipment. (See this issue.)

Vietnam.—9th March. Eighteen 3·5 kW generating plants. (E.S.B. 3094/57.I.C.A. Ten/23999.)* Radio transmitters, receivers and various electrical equipment. (E.S.B. 3098/57.I.C.A. Ten/24016.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Cardiff.—Corporation Parks, Baths and Cemeteries Committee. Recommended. Electrical services in connection with the Wales Empire Pool (£37,132).—Troughton & Young.

Carlisle.—Newcastle-upon-Tyne Regional Hospital Board. Electrical work at the General Hospital (£3,740).—D. Thomson & Sons.

Lancashire.—County Council Education Committee. Renewal of electrical installation at the Hindley and Abram Grammar School (£4,278).—Marlow Electrical Co.

Newcastle-on-Tyne. — Education Committee. Electrical installation at West Secondary Technical School (£15,188).—A. S. Lowrey & Son. (In place of tender withdrawn).

South Shields.—Corporation. Electrical installation at Mortimer County Secondary School (£12,754).—A. Robertson.

Swindon.—Oxford Regional Hospital Board. Recommended. Installation of electrical services for Stage 1 of Swindon New Hospital (£42,191).—William Steward & Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aldershot.—Houses (74), Longacre estate; borough surveyor.

Basildon. — Church, Timberlog Lane; Hosking & Son, Ltd., builders, Arterial Road, Rayleigh.

Billingham-on-Tees.—Houses (82); E. Shaw, U.D.C. surveyor.

Birmingham.—Two blocks of four-storey flats, Browning Street; Sir Herbert J. Manzoni, city engineer, Civic Centre.

Boldon.—Houses (94), Wellands Lane; J. T. Edmondson, U.D.C. surveyor.

Bolton.—Grammar-technical school, Radcliffe Road; Bradshaw, Gass & Hope, 19, Silverwell Street.

Bradford.—Five-storey mill on industrial site at Low Moor; John Reddihough, Ltd., wool merchants, 21, Little Horton Lane.

Bristol.—Office block, Quay Street; Richard Costain, Ltd., builders, St. George's Road.

Burton-on-Trent.—Reorganisation, including casualty and out-patients' departments, at the General Hospital (£250,000); Birmingham Regional Hospital Board, Augustus Road, Edgbaston, Birmingham.

Bury.—Houses (52), Warth Scheme; J. Chadwick, borough surveyor, Bank Street.

Bushey.—Showrooms, offices, workshop and garage, Chalk Hill/Vale Road site; Bushey Vale Garages, Ltd., London Road.

Cambridge.—Laboratories; Medical Research Council, 38, Old Queen Street, London, S.W.1.

Cardiff. — Nursery accommodation in grounds of Suffolk House (£40,000); E. C. Roberts, city engineer, Cathays Park.

Cockermouth.—Houses (36), at Broughton Moor, for the R.D.C.; Oldfield, Simpson & Saul, architects, National Provincial Bank Chambers, Workington.

Consett.—R.C. church (£40,000); A. Rossi, architect, 15, Melbourne Street.

Houses (100); E. Simpkin, U.D.C. surveyor, Medomsley Road, Consett, Co. Durham.

Darlington.—Corn exchange, Clifton Road/Victoria Road corner site; E. R. Tornbohm, borough architect, Central Buildings.

Dudley.—Houses (314), Russells Hall estate; borough architect.

Dundee.—Houses (394), Mains of Fintry; Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh.

Exmouth.—Teaching and administrative block, Rolle College; A. N. Coles, Ltd., builders, Sutton Road, Plymouth.

Fleet.—Houses (52), Basingbourne estate; U.D.C. surveyor.

Gateshead.—Two-storey bank premises, High Street; Martins Bank, Ltd., North Eastern District Office, 22, Grey Street, Newcastle-on-Tyne.

Glasgow.—Warehouse and offices, Anderston Street; Arthur Guinness, Sons & Co., Ltd., Clydeferry Street.

Gosport.—Rebuilding Ritz Cinema; A. E. Cogswell & Sons, architects, Prudential Buildings, Commercial Road, Portsmouth.

Grantham.—Police headquarters at Stonebridge, for Kesteven Standing Joint Committee; county architect, County Offices, Sleaford, Lincs.

Great Yarmouth.—Workshops and offices, Acle New Road; Arlington Motor Co., Ltd., High Road, Ponders End, Enfield.

Houses (97), Magdalen College estate; borough engineer.

Hartlepool.—Houses (52), north of King Oswy Drive; John Wilkin, borough engineer.

Hatfield.—Houses (48), Dellsome Lane, Welham Green; J. H. Parker, architect to R.D.C., 82, Great North Road, Hatfield.

Huntingdonshire.—Grammar school, Orton; S. Holloway, county architect, County Buildings, Huntingdon.

Kettering.—Flats (36), Windmill Avenue; borough engineer.

Leamington Spa.—Fire brigade headquarters and fire station at Beech Lawn; G. R. Barnsley, county architect, Shire Hall, Warwick.

Leeds.—New hospital block at Seacroft Hospital (£60,000), for "B" Group Hospital Management Committee; secretary, Park Parade, Harrogate.

Leytonstone.—Factory, Church Road; Chas. Lewis Shoes, Ltd., 46, Carlisle Road, London, E.10.

Lichfield.—Central boiler house, engineering services, etc., at St. Michael's Hospital (£73,000); Birmingham Regional Hospital Board, 10, Augustus Road, Edgbaston, Birmingham, 15.

Liverpool.—Initial instalment of five 11-storey tower blocks of flats on four separate sites in the city; Architectural and Housing Department, Blackburn Chambers, Dale Street.

[*Continued on next page*

WORK IN PROSPECT (*Continued*)

London.—Extensions to Chelsea Polytechnic, Manresa Road, Chelsea; Mumby & Smith, architects, 1a, Middle Temple Lane, E.C.4.

Office block, Upper Thames Street and Dowgate Hill, City; A. Roberts & Co., Ltd., builders, 79, Eccleston Square, S.W.1.

Factory, Western Avenue, North Acton; Fredk. Coyle & Co., Ltd., builders, 61, High Street, Brentford.

Dwellings (93), Sutherland Grove, Wandsworth; borough engineer.

Mansfield.—Two blocks of shops and flats, Ladybrook Lane, Site 5/B; borough surveyor, Carr Bank.

Nelson.—Phase 2 of scheme for College of Further Education at Reedyford (£115,520); G. Noel Hill, county architect, Fishergate Hill, Preston.

Newcastle-on-Tyne.—Conversion of Grand Cinema to a confectionery factory; A. Reynolds, 8, Cottenham Street.

Northern Ireland.—Factory at Strabane, Co. Tyrone, for the Ministry of Commerce; J. V. T. Scott, architect, 22, Lombard Street, Belfast.

Oxford.—Grammar school, Littlemore; county architect, Park End Street Offices, Oxford.

Peterborough.—Private housing estate near Fulbridge Road; Jellings Builders, Ltd., Walpole Street.

Plymouth.—Cinema, Derry's Roundabout; 20th Century Fox Film Co., Ltd., 31, Soho Square, London, W.1.

Romford.—Flats (42), Romside estate; Tagg & Egerton, Ltd., builders, Albert Road.

Salford.—St. Lawrence R.C. Secondary School, Weaste Lane; W. & J. B. Ellis, architects, Barclays Bank Chambers, St. Helens.

Sandy.—Bungalows (20) and houses (18); U.D.C. architect, Sandy, Beds.

Sedgefield.—Houses (300); R. Dobson, R.D.C. architect.

Sheffield.—Buildings for chemical engineering and fuel technology at St. George's Square, for University Authorities; J. Beaumont & Sons, architects, 13, Collegiate Crescent, Sheffield, 10.

Sherborne.—C. of E. secondary modern school; Petter, Warren & Royden Cooper, architects, West Hendford, Yeovil.

Skipton.—X-ray, casualty, out-patient, pathological, physiotherapy, and other departments at the General Hospital; W. A. Shee, secretary, Leeds Regional Hospital Board, Park Parade, Harrogate.

Somersham.—Houses (10) and bungalows (20) for the R.D.C.; C. W. Shelton, Rutland House, Eastgate, Peterborough.

South Shields.—All-electric flats (243), St. Mark's site; J. Reid, borough engineer.

Stevenage.—Houses (279), Bandley Hill; chief engineer to Development Corporation, Aston House, Stevenage, Herts.

Stockton-on-Tees.—New St. Cuthbert's Church, Yarm Road; J. McCreton, Ltd., builders, Kings Road, Middlesbrough.

Stretford.—Offices and warehouse, Boyer Street/ Talbot Road site; G. H. Gilkes & Co., Ltd., importers and exporters, 4, Clarence Street, Manchester, 15.

Sunderland.—Branch technical college; borough architect, Grange House, Stockton Road.

Tamworth.—Four four-storey blocks of flats and maisonnettes, Boleridge site; borough surveyor.

Tickhill.—Houses (34) in Sunderland Street; U.D.C. architect, Tickhill, Yorks.

Tunbridge Wells.—Factory, North Farm estate; H. E. Daniel, Ltd., drugs and chemicals, St. Barnard Works, Stoney Lane, London, S.E.19.

Tynemouth.—Eighteen blocks of five-storey flats at Percy Main; Wimpey & Co., Ltd., Orchard House, Newcastle-on-Tyne.

Wallsend.—Technical school; G. Gray & Partners, Camden Street, North Shields.

Wanstead and Woodford.—Flats (37), and garages (8), Cross Road, Woodford Bridge; A. McCarlie Findlay, town clerk, Municipal Offices, High Road, London, E.18.

Wells (Somerset).—Factory, showrooms and offices; Messrs. Clares, Town Hall Buildings.

Whitehaven.—Factory, North Shore; Smith Bros. (Whitehaven), Ltd., North Shore.

Whittlesey.—Houses (60) on the Northgate estate; Rose & Sons, Ltd., Northgate, Whittlesey, Cambs.

Wigan.—Houses (101), Marsh Green estate; G. Keighley, borough engineer, Library Street.

Willesden.—Blocks of flats, South Kilburn (£92,940); H. T. Oliver & Sons, builders, 371, Clapham Road, London, S.W.9.

Wolverhampton. — Reorganisation and development of New Cross Hospital (£750,000); Birmingham Regional Hospital Board, Augustus Road, Edgbaston, Birmingham.

Wood Green.—Four-storey building proposed as reconstruction of premises in Bounds Green Road; Vincent Burr & Partners, architects, 85, Gower Street, London, W.C.1.

Wortley.—Houses (52), Pilley, near Barnsley; Arthur Wikeley, R.D.C. surveyor, Council Offices, Grenoside, Sheffield.

York.—Warehouse and offices; Yorkshire Factoring Co., Ltd., St. Saviourgate.

INDIA'S ELECTRICAL IMPORTS

AFTER a temporary decline in India's electrical imports during the fiscal year 1954-55, her imports increased by about 30 per cent during the twelve months ended March, 1956. Of a total of Rs.354·6 million, electrical machinery accounted for Rs.199·4 million; the balance represented goods and apparatus. The share of the United Kingdom was 58 per cent as against 62 per cent the year before.

The accompanying tables show the progress of some of the major supplying countries and the import values of various products. As in former years, increasing foreign competition, especially from West Germany, Holland, the United States and Japan, was felt during the period under review. While West Germany competed in the whole range of electrical products, the United States and Japan concentrated mainly on domestic appliances and insulators, Holland on electronic products, and Sweden and Belgium on transformers. The change in Russia's policy of economic isolation was coupled with the launching of an economic offensive in under-developed countries, including India. The Soviet block, with Hungary and Czechoslovakia as spearheads, are strongly endeavouring to increase their influence by offering technical help and low-priced capital equipment on long-term, low-interest credits, and by increased publicity for their products in India's technical Press and at exhibitions.

Table 1.—Indian Electrical Imports by Countries (thousand rupees)

Group and Country	12 months ended March	
	1955	1956
Instruments, apparatus, appliances, and parts, excl. radio apparatus and components ...	114,576	155,197
From United Kingdom ...	67,462	96,297
,, *Hongkong* ...	5,403	5,403
,, *West Germany* ...	10,909	17,145
,, *Holland* ...	9,443	7,349
,, *United States* ...	11,022	10,884
Electrical machinery ...	157,954	199,416
From United Kingdom ...	102 633	109,875
,, *United States* ...	12,225	16,527

Table 2.—Details of Principal Imports (thousand rupees)

Class	12 months ended March	
	1955	1956
Motors	14,089	15,969
Generators, alternators and dynamos	19,618	31,169
Turbo-generator sets	13,123	10,350
Other electrical machinery ...	36,565	56,641
Transformers	16,252	17,340
Control and switchgear ...	58,305	67,964
Switchboards (other than telephone or telegraph)	685	462
Insulators	1,203	642
Electrical goods and apparatus...	19,973	26,992
From United Kingdom ...	10,440	13,122
,, *United States*	3,540	4,650
Radio receivers	1,128	1,767
From United Kingdom ...	350	775
,, *Holland*	446	359
,, *West Germany* ...	170	299
Radio valves	1,466	3,016
From United Kingdom ...	718	1,405
,, *Holland*	659	1 314
,, *United States*	68	158
Radio components (other than valves)	6,431	10,906
Other components	3,220	5,200
Radio apparatus	12,245	20,890
From United Kingdom ...	5,932	9,709
,, *United States*	2,515	2,831
Fans and parts	1,255	2,054
Cables and wires	41,235	64,759
From United Kingdom ...	31,403	52,247
Of which (from all sources):—		
Bare copper conductors ...	975	1,020
Plain aluminium conductors and a.c.s.r.	935	1,071
Rubber insulated cables, wires and flexes up to 660 V	5,192	7,001
Ditto n.e.s.	226	2,747
Plastic insulated cables, wires and flexes ...	584	876
Paper insulated power cables	18,305	34,318

Class	12 months ended March	
	1955	1956
Cables and wires—*continued*		
Telephone cables	5,179	1,004
Cables and wires n.e.s. ...	9,839	14,912
Resistance wires	—	141
Winding wires	—	1,669
Lamps (gasfilled) electric ...	327	210
,, (vacuum) electric ...	146	714
,, for vehicles	23	49
Torch bulbs	1,002	1,923
From Hongkong	580	819
,, *Holland*	362	474
Fluorescent lamps	2,111	1,062
Other lamps n.e.s.	245	2,285
From United Kingdom ...	558	812
,, *Holland*	785	660
,, *United States*	373	194
Flashlights or torches and parts	4,950	4,518
From Hongkong	4,781	4,405
Telegraph and telephone instruments, and apparatus ...	8,544	10,106
From United Kingdom ...	7,017	7,968
Batteries for flashlights	—	95
Ditto, others	2,582	6,393
Carbons (including electrodes)	3,994	3,657
From United Kingdom ...	730	680
,, *United States*	2,562	2,304
Accumulators and parts ...	4,099	4 201
From United Kingdom ...	2,753	3,357
Condensers	939	1 232
Bell apparatus (excl. telephone and telegraph)	339	420
Lighting accessories	5,031	5,133
From United Kingdom ...	3,536	3,547
Instruments	7,081	11,029
From United Kingdom ...	4,801	5,591
,, *Switzerland*	826	1,211
Electro-medical apparatus, incl. X-ray	4,407	5,127
From United Kingdom ...	698	867
,, *United States*	1,852	1 071